JULY

+ Reg. U.S. Pat. Off.

25 Cents

Popular Science

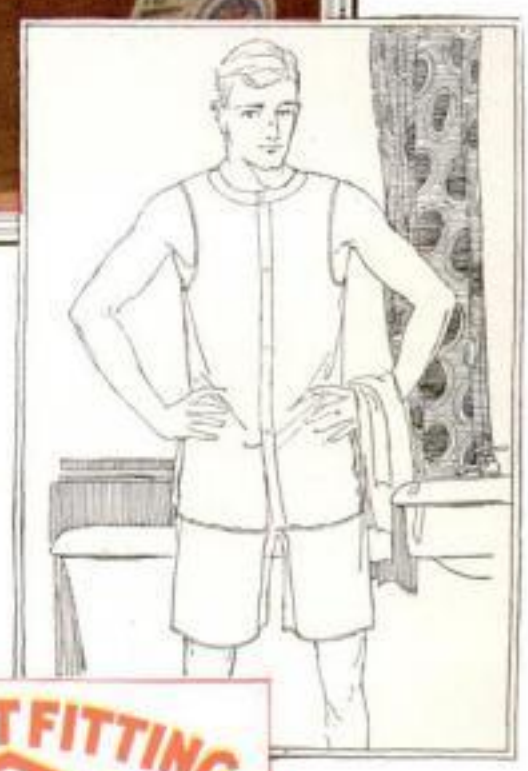
Founded MONTHLY 1872

★

300 Pictures

Cup Racing Become a Science—*See page 1*

300 New Ideas in Automobiles—Mechanics—Wireless—Inventions



Shirts-and-Drawers $1.00 each

"Like yours—and for 50 cents LESS."
"Yeah? Me for Topkis after this!"

A STUFFY night in the narrow confines of the "sleeper," then—oh, boy!—the dash for the washroom and the cool, clean suit of Topkis Athletic Underwear.

Topkis? Yes, *sir!* Topkis—with its loose-cut lines, its featherweight nainsook that rests ever so lightly on your shoulders and barely touches you elsewhere.

Topkis—that is made with the care and stitch-strength of the individually hand-tailored garment. Topkis—*that sells at the most reasonable prices!* Yes, actually. Unions at $1.65, also shirts-and-drawers at $1.00 the garment. At the low Topkis price, you'll want to buy a half-dozen suits at a time. Look for the red-diamond label.

PERFECT FITTING
TOPKIS
BEST QUALITY

Union Suits $1.65 each

TOPKIS BROTHERS COMPANY
WILMINGTON, DEL.
General Sales Offices, 350 Broadway, New York City
Also Makers of Women's, Children's and Boys' Athletic Underwear

TOPKIS
Athletic Underwear

Popular Science Monthly

JULY, 1920

Volume 97-No. 1

CONTENTS

(Continued on page 4)

POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States, $3.00. Canada, $3.50. Foreign, $4.00. Single copy, 25 cents.

POPULAR SCIENCE MONTHLY may be had at all newsstands in the United States and Canada; also from the International News Company, London, and at Brentano's, Paris.

Advertising rates on application. Forms close the twentieth of the second month preceding date of publication. Entered as second-class matter Dec. 28, 1915, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada.

Modern Publishing Company

25 West Thirty-ninth St. New York City

They Dared to Laugh in the Face of Death

The Whole Wonderful Story of the Gripping Heroism and Bravery of our Soldiers in France as Told by Themselves in the Stars and Stripes, the Official Newspaper of the A. E. F. All of the 71 Overseas Issues, Now Bound in One De-Luxe Volume, Form a Priceless Souvenir of the Great War

One of the famous series of cartoons by Walgren, drawn at the front, which appeared each week in the amazing war newspaper of the A. E. F., "The Stars and Stripes"

HERE is the most remarkable human document that has come out of the world war. Here is a living, breathing record of the lives of two million men in war—written by the men themselves as they fought through the devastated wastes of France. Every page of this amazing record breathes of the flaming courage and spirit of men who dared to laugh in the face of death.

Nowhere else in the world will you find a written history comparable to the vivid, realistic, day-by-day account of our soldiers in France as set down in the overseas Stars and Stripes, the newspaper our soldiers wrote and published over there in the thick of the fight. In no other war has such a record been kept, for the Stars and Stripes constitutes the whole story of the war as the doughboys themselves saw it first-hand in all its hardship, grimness, and tragedy. In this remarkable newspaper appeared pictures drawn by soldiers who lay in shell holes, crouching as the crashing explosions of shells spattered them with mud and then peeped over the top to sketch what they saw. Stories of charges through the death-haunted mists of No Man's Land were scrawled on dirty scraps of paper by men who laid aside their guns to tell of the stirring things they had witnessed. Poems that were epics of the humor and pathos of the doughboy's life were written in the gloom of damp and dismal dugouts—some of them by men who lived only a few short hours after.

The Most Amazing Chronicle of Its Kind Ever Written

Such a paper is history unparalleled. It is more than history—it is life itself. But not the dark, dismal kind of life that you might imagine. For the American doughboy carried a smile with him that made him famous among the armies of the world. This smile of his is reflected from every page of his paper. Even in the blood and pain of battle, the doughboy saw something that stirred his humor. Reading the doughboys' account of "his" war is the next thing to being there yourself. Such a record has never been kept before. It is a priceless document that will live forever to be read and reread by generations to come—an inspiring record of the dauntless spirit of the American soldier in the greatest war of history.

A Beautiful, Lasting Souvenir of the Great War

The Stars and Stripes is the only publication of its kind in the history of the United States. It was originally intended only for distribution among the men of the A. E. F. in France, but its fame grew and spread and many copies found their way back to the States. These are highly treasured and jealously held by their fortunate owners. Fabulous prices have been paid for single issues.

Finally there sprang up an insistent demand throughout the country for complete files of this unique, historical publication.

All the Overseas Issues of The Stars and Stripes in One Complete Bound Volume

To satisfy this demand all the overseas issues have now been bound into one De-Luxe Volume—with sturdy khaki-colored covers—richly embossed—a beautiful lasting edition that you will treasure now and hand down to your children. The first issue of the Stars and Stripes was published February 8, 1918—the last, June 13, 1919. There were 71 issues, each paper consisting of 8 pages, 18½ x 24½ inches in size and every number appears in this beautiful bound volume. Each issue of the original newspaper has been reproduced, line for line, exactly as it was printed in France.

Limited Edition—Reserve Your Copy Now

Think of having a complete file of this historic newspaper—the most unique souvenir of the war! You will find endless fascination in the many great features that an army eagerly read—Walgren's famous cartoons, Baldridge's drawings, the Poets' Column, the Letters of Henry's Pal to Henry, the Liars' Column, Captain Hansen's official accounts of the battles, skirmishes, and marches, the histories of the Divisions and Divisional insignia, etc.

This edition of the complete file of the overseas Stars and Stripes—this unique, intimate, and human record of the great war—is limited. Hundreds of reservation orders have already been placed and more are pouring in each day. It is probable that the entire edition will be quickly subscribed. Place your order to-day to avoid dissapointment.

SEND NO MONEY

Clip and mail the coupon quick! We will reserve a copy of this limited edition of the overseas Stars and Stripes for you and ship it to you by express as soon as it comes from the binders. When it reaches your express office, you can examine it thoroughly. If you decide to keep it, pay your express agent the Special Low Price of $12. Otherwise return it and you will not be out one penny.

This may be your only opportunity to secure a complete file of this historic newspaper. Certainly it will never again be offered at this low price. Therefore we urge you to act quickly. Mailing the coupon puts you under no obligation. It merely signifies your desire to see this great volume—you send not a penny of money—just the coupon. Address:

Eames-Luckett Corporation

Distributors A. E. F. Publishing Ass'n.

Dept. 107-64 W. Randolph St., Chicago, Ill.

— — — — Reservation Coupon—Mail Today — — — —

Eames-Luckett Corporation

Distributors A. E. F. Publishing Ass'n.

Dept. 107—64 West Randolph St., Chicago, Ill.

Please reserve for me one complete bound file of all the 71 issues of the overseas Stars and Stripes, to be shipped to me as soon as it is ready. When it arrives I shall examine it thoroughly and if satisfied I shall pay the express company $12.00. Otherwise, I will return it to you at your expense.

Name. .....

Address. .....

City. ..... State .....

CONTENTS—*Continued*

(Continued on page 6)

FREE TRIAL

No Money Down

10c a day soon buys an Oliver Typewriter—latest model

Before you realize it you have this splendid Oliver paid for. And you get to use it right away—while you pay.

To begin with, you save $43 on the price, for we now sell the $100 Oliver for $57. It is our latest and best model, the No. 9. The finest product of our factories.

We are able to make this great saving for you through the economies we learned during the war. We found that it was unnecessary to have great numbers of traveling salesmen and numerous expensive branch houses through the country. We were also able to discontinue many other superfluous sales methods.

Used by U. S. Steel Corporation, Pennsylvania R. R., National City Bank of New York, Encyclopaedia Britannica, New York Edison Co., Otis Elevator Co., Boston Elevated Railways, and other big concerns.

You may buy direct from us, via coupon. We even send the Oliver for five days free trial, so that you may act as your own salesman. You may use it as if it were your own. You can be the sole judge, with no one to influence you.

Was $100

Let us send you the Oliver for Free Trial. The coupon brings it.

If you agree that it is the finest typewriter, regardless of price, pay for it at the rate of $3 per month. We ask no partial payment in advance. You have over a year to pay. And you'll have the Oliver all that time. There is no need to wait until you have the full amount.

If, after trying it, you wish to return it—we even refund the out-going transportation charges. So the trial does not cost you a cent. Nor does it place you under obligations to buy.

Our new plan has been a tremendous success. We are selling more Olivers this way than ever before. Over 800,000 Olivers have been sold! Oliver popularity is increasing daily.

After August 1, 1920, the price of the Oliver Typewriter will be $64. We are compelled to make this advance because of the increased cost of production. The Oliver remains the same. We will not lower its quality. The addition in cost insures its superiority. The $57 price of the Oliver has been widely advertised. We want to be entirely fair so we notify you in advance of the change.

Mail the coupon for EITHER a free trial Oliver or further information. Be your own salesman and save $43. This is your great opportunity.

Canadian Price, $72 Until Aug. 1, 1920

The OLIVER Typewriter Company

110A Oliver Typewriter Building, Chicago, Ill. (29.02)

Now $57

This coupon brings you a Free Trial Oliver without your paying in advance. Decide yourself. Save $43.

Price advances Aug. 1, 1920, to $64.

Or this coupon brings further information.

Check which you wish.

The OLIVER Typewriter Company

110A Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver Nine for five days free inspection. If I keep it, I will pay $ 7 at the rate of $3 per month. The title to remain in you until fully paid for.
My shipping point is.....
This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....

Street Address.....

City..... **State**.....

Occupation or Business.....

This coupon not valid unless mailed and postmarked before midnight, July 31, 1920

CONTENTS—*Continued*

PRACTICAL WORKERS

RADIO-TELEGRAPHY AND TELEPHONY

QUICK-ACTION ADVERTISING

HERE READERS AND ADVERTISERS MEET TO TRANSACT BUSINESS

Rate 25 Cents a Word, no discounts. Advertisements for the September issue should be received by July 1st.

AUTOMOBILES AND ACCESSORIES

AUTO Motor Supplies. Buick—Michigan—Stoddard—Dayton—Cadillac—Overland—E. M. F. Continental and Buda Motors, all types $50 each and up. Special high tension 2 and 4 cylinder Magnetos $9.50 each. Electric and Gas Head Lamps—Coils—Carburetors—Air Compressors—Generators—Starters, etc. Write for late catalogue. Address Motor Sales Dept. 14, West End, Pittsburgh, Pennsylvania.

SALESMEN—Agents—Everywhere: Sell "Tankli." Modern auto-fuel. Guaranteed; 100 to 200% profit. Every autoist interested. Exclusive territory. Tankli, Cleveland, Ohio.

AUTOMOBILE Parts for all cars—50% off manufacturers' list price. Pistons, connecting rods, cam shafts, crank shafts, cylinders, axles and gears. Our new catalogue and Used Parts Bulletin now ready. Write for it to-day. Service and satisfaction guaranteed. Auto Parts Company, 4108 Olive Street, St. Louis, Missouri.

TIRES. Factory-to-You Prices. Exclusive representative wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8000 Miles. Sample sections furnished. Mellinger Tire Company, 937 Oak Street, Kansas City, Missouri.

VULCANIZING auto tires is a growing and profitable business. Easy to learn. Instruction book, $1. Plants $50 to $300. Details free. Equipment Co., 17 Canal, Cincinnati, Ohio.

HYDRONIZER: Insures clean plugs, consumes carbon, saves gasoline, intensifies power and increases speed. For all cars. Money back guarantee. Big profits for agents. Free literature. Friestedt Manufacturing Company, 2933 West Lake Street, Chicago.

PATENTS—Write for Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest references. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

INSYDE Tyres, inner armor for Automobile Tires, prevents punctures and doubles mileage of any tires. Liberal profits. Details free. American Accessories Co., Dept. 97-A, Cincinnati, Ohio.

RED DEVIL Auto Polish—Brightens the way. Regular 60c. can, 50c to introduce. Agents wanted. Red Devil Products, Dept. 1, Farmingdale, New York.

CHILDREN can fix punctures with Kinsey's Electric-Patch. Instantaneous—Permanent—Guaranteed. Mailed, prepaid for dollar bill. Kinsey Patch Company, Junction, City, Kansas.

SHINELO—Unexcelled Auto Body Polish. Formula, $1.00. A top dressing formula free. John Eberle, West Water, Chillicothe, Ohio.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

VULCANIZERS—Our circular tells how to make blow-out patches from used tire fabric. C. M. Anderson, Batavia, Illinois.

BULL dog inner tires molded to fit your casings. Practically eliminates blow-outs and punctures. Doubles the life of your tires. Wonderful seller and repeat order getter. Write for particulars to-day. Agents making $5,000 to $10,000 a year. Eastern Auto Specialty Co., Dept. B, Utica, New York.

SPEEDSTER—Racingbody—build it yourself at little cost. Send 4 cents for many different styles in pictures. F. Floege, Box 321, North Chicago, Illinois.

BLUEPRINTS of connections for armatures of automobile starters, generators, and motor-generators. See ad under "Electrical." Charles Chittenden.

TIRES at wholesale. We have the cheapest, high-grade, long life and reliable tires in the world. No "seconds" or rebuilt. Send for prices. Overton Tire Company, Oelwein, Iowa.

BUILD your own garage. Blueprints, instruction, list of material needed, $2. Money refunded if not satisfactory. Al. Violett, 52 Park Street, Providence, Rhode Island.

TIRES—50% off the list price on high-grade standard make tires. Guaranteed tubes. Also slightly used standard make tires at very lowest. Special proposition to dealers. $1.50 must accompany each tire ordered. We solicit your trial and satisfaction guaranteed. Volcano Tire Company, 2132 Michigan Avenue, Chicago, Illinois.

MATS Body Polish—"The Best"—A Nationally advertised and used auto body and leather dressing; guaranteed not to contain any grease or oil; leaves a hard, smooth surface that sheds mud and grease like a duck sheds water. Spray it on and wipe it off—that's all. Your money back if it is not exactly as we claim. A quart can enough for three cars. Regular price One Dollar and Fifty Cents. Our special introductory price One Dollar. Special proposition for agents. National Sales Company, 1142 South Michigan Avenue, Chicago, Illinois.

YOUR Spark Plugs need "Protexun" to keep cores from breaking and prevent fires. Fits your regular plugs. Write for details. Iri Hicks, Desk 19, Centralia, Missouri.

BATTERY Charging Profits $100 to $250 Clear Monthly with HB Equipment. Your lighting current or engine operates. No expense to you. Easy payment plan lets outfit earn own way. Satisfaction guaranteed. Write Hobberts, Troy, Ohio.

WIRELESS

SIMPLE Wireless Telephones and How to Make Them. A good book for the advanced radio amateur on the principles, construction and use of the wireless telephone. Price 25 cents postpaid. Book Dept., Popular Science Monthly, 225 West 39th Street, New York.

"SILVERPLATE" without electricity. Bottle "Silverplate" 35c. Roberts, 11718 Detroit Avenue, Cleveland, Ohio.

FORD ACCESSORIES

FORD Speed-Power Equipment stocked: 4 speed forward auxiliary transmissions, doubled pulling power. Increases speed 40 or 20%; 16 valve overhead cylinder head; speed carburetors; camshaft; piston rings; light pistons, crankshaft counter-balances; high tension magnetos; underslung fixtures; speed power bevel gears; foot accelerators; steering wheels; wire wheels; disc wheels; metal wheel discs; Ford fire chemical hook and ladder; 15"-30" double universal wheelbase extension; 1½-2 ton side spring additional frame work unit; complete line 1½-5 ton shaft-chain drive units; facing body; complete racing cars $500. $1750 Special. Instantaneous electric hot-water heater, attachable any faucet, retail $60.00. Dealers $45. Z-Ford Speed-Power Equipment Manufacturers, 250 West 54th Street, New York.

FORDS run 34 miles per gallon with our 1920 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Runs slow in high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days' trial. Air-Friction Carburetor Company, 500 Madison Avenue, Dayton, Ohio.

FORDS double the mileage with Picard Carburetors. Easy starting. Double the power. Satisfaction absolutely guaranteed. Free trial. Agents wanted. York Sales Company, Dept. PS. 1518 East Jefferson Avenue, Detroit, Michigan.

TIMER Brush. New wiping contact; quick starting; easiest running. Only 34 cents, prepaid. R. Sp. Works, Box 543, Riverside, California.

SAVE-ALL Carburetor Attachment makes Fords run better. Gives more miles, power and speed. Free trial. Savall Company, 3716 North Clark Street, Chicago.

OUR Spark Intensifier fires all four cylinders with cracked or worn out plugs, locates ignition troubles instantly and makes your car start easier. Send one dollar for sample and liberal agents proposition. Cyntho Company, Box 476, Seattle, Washington.

FOUR Dollars insures you for life against being kicked by your Ford. Write to-day for our free booklet "Kant-Kick", the safety device for Fords. Easily attached. Buffum Tool Company, Louisiana, Missouri.

"SURE-HIT Timers," $4.00. Something different and guaranteed in writing for two years when used with the L. W. Juice Plug, $3.50. (Not a spark plug.) Both sent prepaid for 7.00 If not more than satisfied with results, we will cheerfully refund your money. Omaha Accessory Company, 1018 Douglas Street, Omaha, Nebraska.

FOR-A-FORD Spark Plug. Exactly like Factory Equipment but with double water jacketed porcelain. Develops more power in your engine—saves gas—and the double porcelain doubles the life of the plug. Guaranteed, nationally advertised and sold for $1.00. Our special introductory price for set of four, $2.50. Sample plug, 75 cents postpaid. Special proposition for agents. Universal Distributing Company, 1142 South Michigan Avenue, Chicago, Illinois.

WELDING AND SOLDERING

DON'T scrap aluminum parts. Save them, with So-Luminum. New, great "3-in-1" welding, brazing and soldering compound, stronger than aluminum—perfect substitute for acetylene welding—⅓ time and cost. Use gasoline torch or soldering iron. No flux. Booklet 9. Sample bar $1.00. Used by United States Army and Navy, indorsed by British Munitions Board. So-Luminum Manufacturing Company, 1790 Broadway, New York.

WELDING PLANTS, $25.00 to $300.00. Designed for all purposes. Small cash payment, balance three to six months. Every mechanic or shop should have one. Bermo Welding Co., Omaha, U. S. A.

AVIATION

"FORD" motored tractor biplane. You can build your own. We tell how to remodel motor and include full size drawings of metal parts and wing curve with our plans and instructions. All for $2.50. Consultation with aeronautical engineer free to builders. Ready made parts at reasonable prices. Circular on request. Aviation Directory, Lawrence, Kansas.

COMPLETE set of drawings of the Liberty 12 Engine. A United States Standardized Aircraft Engine. Giving all views with number of parts, names of parts and weights of parts. Mail $1.00. Dept. E, Ocean Publishing Company, 25 West 42d Street, New York City.

THE American School of Aviation announces a new correspondence course in Mechanics of Aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 189B, 431 South Dearborn Street, Chicago.

HEATH Airplane Co.'s Catalog "N" is the most complete booklet ever published on aeronautical needs. 12c in stamps. Get our pamphlet on Ford and Motorcycle engine-driven airplanes, 4c; also glider circular, 4c. We buy and sell all kinds of aeronautical motors. Heath Airplane Co., Chicago.

INVENTORS desiring information write for our Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

CONSULTING Aeronautical and Motor Engineers. Inventions developed. Designs prepared. Tests and reports. Van Muffling & Marx, City College, New York.

AIRPLANES—1 to 6 passenger; aeronautical motors 30 to 300 HP. Lowest prices. State your needs. Send for lists "P. S." Aero Exchange, 38 Park Row, New York.

TRADE SCHOOLS

COME to a Real School. Learn Sign, Scenic and Auto Painting — Paperhanging — Decorating — Showcard Writing. Catalogue Free. Chicago Painting Schools, 129 North Wells Street, Chicago.

MOTORCYCLES, BICYCLES, SUPPLIES

MOTORCYCLES all makes, $25.00 up. New bicycles at big reduction. Second hand, $8.00 up. Motors, motor attachments. Cycle motors. Smith motor wheels, etc., $20.00 up. New parts to fit all makes carried in stock. Second hand parts good as new 50% discount. Expert repairing, on magnetos, generators, transmissions. Motors overhauled $10.00 up. Henderson motors our specialty. Write for big bargain bulletin. American Motor Cycle Company, Dept. 3, Chicago.

$25.00 Up—Guaranteed rebuilt motorcycles—Henderson, Excelsior, Indian, Harley-Davidson. Bicycles, $5.00 up. Tires and accessories at wholesale. Illustrated bulletin "A" free. Ash Motor Corporation, 162 North Clinton Avenue, Rochester, New York.

USED Motorcycle Bargains: Indians, Excelsiors, Harleys, $40.00 up. Singles or twins. Overhauled, rebuilt and tested by experts. Shipped on approval and guaranteed. Send stamp for Big Free List. We furnish bank references. Floyd Clymer, Desk A, "Largest Motorcycle Dealer in Western America," Denver, Colorado.

REBUILT Motorcycles—New 1920 Spring list: Harley-Davidsons, Indians, Excelsiors, Hendersons, and sidecars $50.00 to $375.00. Every machine rebuilt and guaranteed as represented. Write for new folder B. Carl W. Bush Co., 519 Broad St., Newark, New Jersey.

POWER Cycles. Fifty miles an hour. Hundred miles per gallon. New, complete, horn, electric lights, $145.00. Rear seat, side car, extra. C. Keller, Campgaw, New Jersey.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MANUFACTURING

WE do Metal Stamping, Die and Model Work, Gold, Silver, Nickel, Copper and Brass Plating; also special finishes. We will manufacture your article either on straight time or contract basis. When our tool or model maker is on your job, you are welcome at his bench. Denning Manufacturing Company, 1775-1777 East 87th Street, Cleveland, Ohio.

TO Order: Any article in metal; models, tools, patterns, experimenting, manufacturing. Inventions developed. Cleveland Specialty and Manufacturing Company, Cleveland, Ohio.

CENTRAL Machine Works, St. Louis, Missouri. Special Machinery builders manufacturing in any quantities, dies, tools, battery moulds, stampings and parts.

FOR BOYS

HERE Boys! Read Nifty Toy Company's ad on page 124.

WANTED

CASH for Old False Teeth. We pay up to $35.00 per set (broken or not). Also buy discarded gold jewelry, gold crowns, bridges, platinum, diamonds, watches and silver. Send now. Cash by return mail. Package held 5 to 10 days for senders' approval of our offer. U. S. Smelting Works, Dept. 81, Chicago, Illinois.

WANTED—Small gasoline and steam engines. Drill presses, lathes, electric motors, etc. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pennsylvania.

WANTED—Representatives in every Factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

WANTED:—Small Gasoline and Steam Engines, Electric Motors, etc. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pennsylvania

IT'S Like Finding Money when you mail us false teeth (with or without gold fillings), old or broken jewelry, diamonds, watches, old gold, silver, platinum, magneto points, gold or silver ores or nuggets—War Bonds and Stamps. Highest prices paid. Cash by return mail. Goods returned if you're not satisfied. The Ohio Smelting and Refining Company, 238 Lennox Building, Cleveland, Ohio.

PARTY to finance Gem Pictures—Kaiser's Secrets in Holland. Peter Eagle, 131 E. 114th Street, New York.

FOR SALE AND EXCHANGE

CHOICE silver black breeding foxes. Instructions. Reid Brothers, Bothwell, Ontario.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MECHANICAL drawing instrument outfits a special bargains, send for our catalogue. National Instrument Company, Box 1707, Denver Colorado.

LET'S swap! What've you got? What d'ye want? Three months, dime. "The National Exchange Medium," Detroit.

ELECTRICAL

BLUEPRINTS—Electrical connections. 236 A. C. motor, single, two, and three phases. Voltage, cycle, phase, speed changing. 123 D. C. Voltage changing, etc. 120 transformer connections. 172 rheostats, controllers, compensators, both internal and external connections. 175 diagrams covering 250 armatures for automobile starters, generators, and motor-generators, with complete rewinding data. 10 samples A. C. connections, 25c. Particulars free. Charles Chittenden, Dept. S, 3024 Matthews Avenue, Kansas City, Missouri.

ELECTRICIANS, Wiremen, Linemen, send your name and address for descriptive literature of our Modern Blue Print Chart Method of Electrical Wiring. Over 350 practical diagrams. Electrical Wiring Diagram Company, Box B173, Altoona, Pennsylvania.

SELENIUM CELLS—Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up. Write for Catalog. Selenium Laboratories, Good Ground, Long Island, New York.

MAKE Dry Batteries. Simple, practical instructions, with blue print, 25 cents. Dirigo Sales Company, Bath, Maine.

ELECTRIC Telephones, 2 receivers, 2 transmitters; complete with diagrams, $1.00. Inland Specialty Company, 1560 North Robey Street, Chicago.

MOTORS, ENGINES, MACHINERY

SMALL Motors and Generators.—⅛ H. P. A. C. $22.75—¼ H. P. $38.50—½ H. P. A. C. $67.50—Battery Charging Sets—Charging, Lighting and Moving Picture Arc Generators—Motors for all phases of current. Prompt delivery—Wholesale prices. Write for late catalogue. Address Motor Sales Dept. 14, West End, Pittsburgh, Pennsylvania.

FORMULAS

TO manufacture products that bring repeat orders, you need dependable formulae as a foundation. We supply guaranteed formulae for such specialties as soldering alloy for aluminum; paint and varnish remover; fire extinguishing compound (dry form); solidified alcohol (for heating); non-inflammable metal polish, $1.00 each. Lists, 2c. Industrial Methods Bureau, 1B West 34th Street, New York.

500 Formulas—Trade wrinkles, secrets, discoveries. All easy, successful money-makers. Everything, 25c. Edgar James, 315 Douglass, Indianapolis, Indiana.

PROFITABLE money-making processes. Details of manufacture accompanying each formula. Send for list. F. N. Beardslee, 1369 Broadway, New York.

500 successful money-making formulas and trade secrets. Postpaid, 25c. Charles Dynes, Winchester, Indiana.

GUARANTEED Formulas—Rubber tire cement—auto polish—puncture plugger—soldering paste—resilvering mirrors—luminous paint—mechanics soap—renewing dry batteries—20c each. Entire collection 50c. Formula catalog free. S. & H. Manufacturing Laboratories, 15602 Boylston Building, Chicago.

SELF-SHINING shoe polish formula, 25c. Al. Tytler, Monterey, California.

FORMULA—Powder to make ice in summer. Freezes water solid, $1.00. Formula—Inexpensive substitute for butter. Absolutely pure, $1.00. Formula—Egg Dip. Keeps eggs strictly fresh indefinitely, $1.00. 20,000 honest, high-class, workable formulas including all of above $3.00. Nearly all new. Free assistance in starting business. Money refunded if not satisfied. C. J. Callender, Square Deal Mail-Order Man, 3237 Garfield, Kansas City, Missouri.

FORMULA—Tooth Paste. Make your own. Sell to friends; big profits. Postpaid $1.00. DeWitt Laboratory, 338 North 42nd Street, Philadelphia, Pennsylvania.

DUPLICATING DEVICES

"MODERN" Duplicator—a Business Getter, $1.50 up. 50 to 75 copies from pen, pencil, typewriter; no glue or gelatine. 35,000 firms use it. 30 days' trial. You need one. Booklet Free. J. V. Durkin & Reeves Company, Pittsburgh, Pennsylvania.

FOR THE HOME

GRANDFATHER'S Clock Works $5.00. Build your own cases from our free instructions. Everybody wants a hall clock. You can make good profit building artistic clocks for your friends. We replace worn-out works in old clocks with works having chimes at money saving prices. Write for folder describing the most beautiful hall clock ever sold at $25.00. Clock Co., Nicetown, Pennsylvania.

OUR Leather Preservative doubles the life of your shoes or any leather goods. Sample and booklet 35c. Belgian Specialty House, 2805 Union Avenue, Chicago.

SHINE your own shoes. Save money. Our all metal adjustable shoe-shining bracket makes it easy. No bending. No stooping. Holds any size men's or women's shoes firmly. Sent prepaid for $2.50 in U. S., Canada $3.00. Agents wanted. F. S. Kay, S1733 Republic Building, Chicago, Illinois.

CLEAN your Wall Paper, and remove that dust, dirt, and grease spots. Complete instructions, only one dollar. James T. Herr, 2919 West North Avenue, Baltimore, Maryland.

HEALTH

LAXATIVE Fruit Cake. Entirely vegetable. Delicious, harmless, effective. $1 a carton prepaid. Laxative Fruit Company, Box 1234, Avalon, California.

FIRST Aid Kit—Medical, Surgical, with Directions. Prepaid, $5.00. Order to-day. Jaquet & Lessel, Falls City, Nebraska.

LABORATORY AND CHEMICAL

EXPERIMENTAL laboratories, $11.00 to $100.00. Payment plan or cash. Actual photographs free. Write Dept. S-27. Lions Scientific Institute, "Laboratory Outfitters," Mt. Oliver, Pittsburgh, Pennsylvania.

GUMMED LABELS

PAYNE "Stick-Tight" Gummed Labels—used the world over. Payne-Standard Company, Box 121-K, Passaic, New Jersey.

PRINTING, ENGRAVING, MULTIGRAPHING

GOOD Printing at low prices. 1,000 good letterheads, envelopes, cards, billheads, labels, circulars, $2.50; samples free; catalogues, booklets and circulars our specialty. Ernest F. Fantus Co., 523 S. Dearborn St., Chicago, Ill.

MULTIGRAPH Letters build business. Most economical and effective advertising. Printing, Addressing. Low rates; careful work; service. Multigraph-Peerless Letter Company, 241 Fourth Avenue, New York.

5000 Gummed Labels, $1.50. Catalog. Irwin Wolf, Station E, Philadelphia.

100 Cards, business, professional or social, also imitation leather card case, for 60 cents. M. F. Devaney, Printing, Engraving, Rubber Stamps, 31 Middle Street, Geneva, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

250 BOND LETTERHEADS, and Envelopes, $2.25. Other printing, lowest prices. Samples, 4c. D. F. Ball and Company, Dept. 26A, Buckland, Connecticut.

LETTERHEADS $2.50 thousand. Samples free. Quality Print Shop, Marietta, Ohio.

BUSINESS and Name Card specimen sheets on request. Star Press, Box M37, Winchester, New Hampshire.

1,000 LETTERHEADS, envelopes, cards, etc., $3.00 and less. P. S. Orvis, Hackensack, New Jersey.

GOOD printing quick—at lowest prices. Samples free. Bamberg Printing Company, 2245 South Kedzie, Chicago.

GOOD Printing Reasonable. Machine composition, automatic printing presses, automatic envelope machinery. We print anything. Get our prices. A. H. Kraus, Kraus Building, Milwaukee, Wisconsin.

GUMMED Labels! Rubber stamps. Samples free. Edward Harrison, "Printing," Baltimore.

"CUTS" will make your printed matter doubly attractive. Proofs free. Mailpress, 2031 Vine Street, Cincinnati.

"ACTUAL" Typewritten Letters, heading, printer's type, black; body, purple, blue or black typewriter type. 100, $2.75; 500, $4.00; 1,000, $5.50; 5,000, $17.50. Artus Letter Shop, 400 Chestnut Street, Milwaukee, Wisconsin.

ADVERTISING SERVICE

1000 Advertising Headlines and Showcard Suggestions. Inspiration for advertisers. Mailed on receipt of 50c. Money back if you return book. Richards School of Advertising, 4305 Cottage Grove, Chicago.

SPECIAL! 1,000 co-publishers wanted! Sample-Particulars-Registration, $1. Globe Syndicate, Atlantic City

SPECIAL! Whole Page Display advertisement 150 Magazines Thrice $150. Popular Globe Syndicate, Atlantic City.

LETTER SPECIALISTS

WHOLESOME, Human, Persuasive Sales Letters; free folder. Friend Cook, 103P Park Avenue, New York.

MR. Business Man—Mail-Order Letters that have "pull," and "produce." I write. Camille Plumer, 1121 South Main, Waterbury, Connecticut.

MAILING LISTS

5,000 different classifications, 1919-1920. Largely $2.00 per thousand addresses. Rightquick Publicity Bureau, 1314 Arch Street, Philadelphia, Pennsylvania. Established 1907.

OFFICE AND FACTORY EQUIPMENT

ADDRESSOGRAPHS, Multigraphs, Folders, Sealers, duplicators bought and sold. Office Device Company, 154A West Randolph, Chicago.

"ALL-IN-ONE" System—Revolutionizes Bookkeeping. John Capehart, Russellville, Kentucky.

MULTIGRAPHS, Addressographs, Duplicators, Sealers, Folders, less than half price. Guaranteed one year. Truitt Company, 112-M North La Salle, Chicago.

ADDING MACHINES

WONDERFUL Adding Machine, seven columns capacity, only one dollar. Adds and multiplies as fast as the fingers will move. Thousands being sold through demonstration. L. J. Leishman Company, Dept. L, Ogden, Utah.

MARVELOUS new Automatic Adding Machine. Retails $12.50. Work equals $300 machine. Five-year guarantee. Write for trial offer. Calculator Corporation, Dept. P, Grand Rapids, Michigan.

TYPEWRITERS AND SUPPLIES

NEW, remanufactured and slightly used Typewriters $8.00 up. Portable Machines $10 up. Write for our Catalog 25G. Beran Typewriter Company, 58 West Washington Street, Chicago.

MISCELLANEOUS

ELECTRICAL Tattooing Machine, $3, $5, and $7. Catalogue for stamps. J. H. Temke, 1019 Vine, Pem., Cincinnati, Ohio.

BALDNESS. Indian's recipe for growing hair; astonishing success. Proof box mailed for 10 cents. John Hart Brittain, 150 East 32nd Street, BA-188, New York.

TELEGRAPHY

TELEGRAPHY (both Morse and Wireless) and railway accounting taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School. Established 45 years. Catalog free. Dodges Institute, 2nd Street, Valparaiso, Indiana.

AMERICAN MADE TOYS

WE Offer an opportunity to manufacturers with facilities for large production, also to homeworkers on smaller scale, to manufacture Metal Toys and Novelties. Unlimited field and enormous business open for ambitious people. No experience required. No tools needed. Our castingforms turn out goods complete. Since the different Toy Expositions, manufacturers are covered with orders until December. You can enter this field now, by manufacturing "American Made Toys." We furnish castingforms for Toy Soldiers, Army, Navy, Marine, Cannons, Machine Guns, Indians, Cowboys, Warships and other novelties. Casting forms complete outfit $5.00 up. We buy these goods, direct from manufacturers. Yearly contract orders placed with reliable parties. We pay very high prices for clean painted goods. Samples furnished. "Bird-Whistles" great seller, just added to our stock list. Booklet, Information, Instruction free, if you mean Work and business. No others invited to write. Toy Soldier Manufacturing Company, 32 Union Square, New York.

MODELS AND MODEL SUPPLIES

INVENTORS before ordering your models or having machine work done, ask for our illustrated booklet. Central Machine Works, St. Louis, Missouri.

PATENTS—Book free. Send sketch for free Opinion of patentable nature. Talbert & Talbert, 4848 Talbert Building, Washington, D. C.

BLUEPRINTS

BLUEPRINTS: Learn Blueprint Reading from 33 Large Blueprints. It matters not what line you are in. We show you how. It's easy: it's job insurance. Get our circular or send $1. We will mail you first four Blueprints. If satisfactory, order balance. Charles J. H. Freeth, Consulting Chief Draftsman, Mechanics' Improvement Association, Dept. 25, 1628 West Lehigh Avenue, Philadelphia, Pennsylvania.

PAINTS, VARNISHES, SUPPLIES

ROOF leaks stopped quickly, permanently; product guaranteed; comes ready for use; thinning unnecessary; does not settle; exclusive territory with free advertising to dependable dealers considered. Martinek Company, Dept. G, 405 Lexington Avenue, New York City.

CIGARS, CIGARETTES, TOBACCO

"SPECIAL Offer. Send $1.00 for box of 50 genuine Turkish Cigarettes. Delightful smoke. Mail your order today, with cash or money order. Yak Ousani Company, 108 Liberty Street, New York.

FOREIGN LANGUAGE STUDY

SPANISH language easily learned at home. Weekly private correspondence lessons. Only $6.00 monthly. 17th successful year. Pruners Studios of Spanish, 180 Broadway, New York.

AUCTIONEERS

AUCTIONEERS—Make big money. Free catalogue. Carpenter's Auction School, Kansas City.

DOGS, BIRDS, PETS

BREED Canaries—Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

FISH, AQUARIUMS, SUPPLIES

GOLDFISH—Imported Japanese, Chinese and American fish; aquarium plants, artistic, durable aquariums. Catalogue. Pioneer Goldfish Hatchery No. 5, Racine, Wisconsin.

ROOTS, HERBS, PLANTS

GATHER Ginseng, $15. Belladonna $65 per lb., or grow them yourself; 200 seeds each with instructions only $1. O. Twitchell, West Milan, New Hampshire.

STAMMERING

STAMMERING and Stuttering positively cured by one who stammered 40 years. Treatment radically different from all others. Tuition moderate. The Quigley Institute, 1727 Master St., Philadelphia, Pennsylvania.

STAMMERING cured—quickly, permanently, and privately. Write for free booklet. Samuel E. Robbins, 246 Huntington Avenue, Boston, 17, Massachusetts.

ST-TUT-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Potomac Bank Building, Washington, D. C.

CANDY

CHERI Super Chocolates, assorted, pound box $1.25, parcel post prepaid, insured. Best you ever tasted at any price or the box with our compliments. Cheri, Inc., 142 South 15th Street, Philadelphia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

PICTURES AND POSTCARDS

JOIN Live Postcard Club. Membership Papers 10c. Harvey Temple, Decatur, Indiana.

BOYS and girls—Join the Western Post Card Club. P. S. Fleming, Mgr., Box 82, Elk, Washington.

SPECIAL—Twenty clever, classy, assorted postcards, 10c prepaid. Swanson, 12058 Kansas Avenue, Kansas City, Kansas.

PHOTOGRAPHY AND SUPPLIES

MAIL us 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Company, 212 Bell Avenue, Roanoke, Virginia.

FILMS developed 5c roll, prints 3c each. Photo Service, 929 McMillan, Cincinnati, Ohio.

CAMERAS—Films, supplies, at reduced prices. Films developed 2c, prints 2c up. Write for free catalog. Pearl Photo Place, 640 East Clementine Street, Philadelphia, Pennsylvania.

SOMETHING different! Polished silvertone prints; six, 20c.; send roll or negatives. "Silvertone," 950-A Lockwood, Chicago.

KODAKER'S Notice: The New Short Process of Developing and Printing will prevent many disappointments with your Kodak Pictures. Send a roll for a trial order. Guaranteed Work. J. F. Short Company, King Street, Charleston, South Carolina.

DISABLED Soldiers Photo Company, 3654 North Halsted Street, Chicago. Films developed, 7c; prints, 3c; each. Give us a trial.

MR. ADVERTISER: Ask to-day for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

FILM Pack or Roll developed, 10c. Prints 2c. (No stamps.) Brown Studio, Lake Elmo, Minnesota.

MUSIC AND SHEET MUSIC

MUSIC—Learn by mail—Graphic Drawings System—Three Lessons comprising Theory, Time, Measure, Charts, start you playing easy tunes. Piano, Violin, Flute, Banjo, kindred instruments. Singing. Single lesson $1.00, Set $2.00. Technon Schools, 128 West 104th Street, New York.

SAXOPHONISTS. Wonderful correspondence course really. Write Virtuoso School, Buffalo, New York.

WRITE the words for a song. We write music, guarantee publisher's acceptance. Submit poems on patriotism, love or any subject. Chester Music Company, 920 South Michigan Avenue, Room 111, Chicago.

WRITE the words for a song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 121C Fitzgerald Building, New York.

WRITE a Song—Love, mother, home, childhood, patriotic or any subject. I compose music and guarantee publication. Send words to-day. Thomas Merlin, 238 Reaper Block, Chicago.

YOU write words for a song—we write the music, publish, and secure a copyright. Submit poems on any subject. The Metropolitan Studios, 914 South Michigan Avenue, Room 106, Chicago, Illinois.

SONG-WRITERS' Manual and Guide Sent Free. Contains valuable instructions and advice. Submit songpoems for examination. We will furnish music, copyright and facilitate publication or sale. Knickerbocker Studios, 315 Gaiety Building, New York.

YOU Write the Words for a Song—We'll compose the music free and publish same. Send Song Poem today. A. G. Lenox Co., 271 West 125th Street, New York.

MUSICAL INSTRUMENTS

WONDERFUL discovery. Make your violin talk. Yes, I mean actually speak words, sing, laugh. $1.00 for the secret. Particulars free. A. Warren, Fairfield, Illinois.

MUSICIANS delight! Music stand and automatic leaf-turner combined. Booklet free. Olsen & Anderson, 1717 Third Avenue, New York City.

PHONOGRAPHS, RECORDS, NEEDLES

BUILD your own phonograph. Big saving. Pleasant instructive work. Complete instructions, blue-prints, etc., absolutely free. Write to-day. Associated Phonograph Company, Dept. F1, Cincinnati, Ohio.

BUILD your Phonograph. "Perfection" high quality spring and electric Motors, Tone Arms, Reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Indiana.

EDUCATIONAL AND INSTRUCTION

EARN $75.00 to $100.00 per week. Write for full information concerning my course in Commercial Art, Designing and Show-Card Writing. Pay and earn while you learn. Oelwein Art Studio, Oelwein, Iowa.

LINCOLN-JEFFERSON University. Home Study in college, Theology, Law, Music. Business and Graduate schools. Usual degrees granted. Lock Box 239G, Chicago.

DOUBLE-ENTRY Bookkeeping mastered with 8 Keys in 60 hours; guaranteed; diplomas; twenty lessons $5. International Bookkeeping Institute, Springfield, Missouri.

CARTOONING, Comics and Lettering in fourteen easy lessons, only $5 postpaid. Over 300 illustrations. Sample lesson free. Ernie's School, Elyria, Ohio.

"PHOTOPLAYS—How to Write and Sell Them." Newest book on scenario writing; teaches everything necessary. Particulars free. Indianapolis Supply Company, 541 East Merrill Street, Indianapolis, Indiana.

PATENTS FOR SALE

AUTOMATIC Drift for removing drills from drill press spindle. Simple; low-cost; time saver; big field. One automatic drift should be provided with every drill press. No hammers necessary to remove drills as in the usual method. Write us for illustrations and details. Cowan Truck Company, Holyoke, Massachusetts.

PATENT number 1323723 for sale. Best invented. Jar closure; self-sealing glass jar. Investigate! Edw. C. Ries, 3409 Wyandotte Street, Kansas City, Missouri.

PATENT No. 1,294,881 Electric Floor and Carpet Washer. R. Dickinson, Appleton, New York.

MOTION PICTURE BUSINESS

$35.00 profit nightly! Small capital starts you. No experience needed. Our machines are used and endorsed by government institutions. Catalog Free. Atlas Moving Picture Co., 441 Morton Building, Chicago.

WRITE Photoplays; $50 each. Experience unnecessary; details free to beginners. Producers' League, 194, St. Louis.

PHOTOPLAYS Wanted. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175, F 26, Chicago.

MAKE money fast. Small capital buys professional machine and complete outfit. Easy payments. No experience required. Openings everywhere. Catalog free. Monarch Theater Supply Co. Dept. 535. Address nearest office: Ellsworth Building, Chicago; 420 Market, St. Louis, Missouri; 228 Union, Memphis, Tennessee.

LEARN how to write photo plays. My book tells how, where to send, gives model, for 50c. Lester deFrates, Box 1416, Boston.

EARN big money writing photoplays. Outline free. Los Angeles Photoplay Company, Los Angeles, California.

AUTHORS—MANUSCRIPTS

FREE to Writers—A wonderful little book of money-making hints, suggestions, ideas; the A B C of successful story and play-writing. Absolutely Free. Just address: Authors' Press, Dept. 15, Auburn, New York.

MANUSCRIPTS typewritten, correctly arranged and punctuated—50c a thousand words. Neatness, promptness. Criterion Service, Dept. A-7, West New York, New Jersey.

BE a Song Writer—you write the words, I will compose the music and guarantee publication. Among my great hits is "Deserland." Submit poems on any subject. Ethwell Hanson, 3810 Broadway, Room 137, Chicago.

WRITE for newspapers and magazines. Big Pay. Experience unnecessary, details free. Press Reporting Syndicate, 400, St. Louis.

WRITERS: Have you a song-poem, story, photoplay, to sell? Submit manuscript now to Music Sales Company, 48, St. Louis.

WRITERS: Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

GAMES AND ENTERTAINMENT

TRICKS and Greenbacks. Big magic catalog 5c. Twenty greenbacks—10c. Gilmagico, 11135 South Irving, Chicago.

DRIPPING Cigarette—Good pocket trick. Roy Fosdick, 217 Shelton, Jamaica, New York.

150 Parodies on latest songs 10c. Charles Dynes, Winchester, Indiana.

OVER the Top puzzle and wholesale joke. Catalogue, 10 cents. Mears, 66, Anderson, Indiana.

BOYS—Bet your baseball cranks they can't spell baseball with this new baseball puzzle. Mystifies young and old. Prepaid, 25 cents. Baseball novelties. P.O. Box 246, Plainfield, New Jersey.

BEAUTIFUL Catalog! Games and tricks of all kinds. 2c postpaid. Beehive Sales Company, RE-1 4103 North Crawford, Chicago, Illinois.

REAL ESTATE—FARM LANDS

OWN Your Own Orange Grove in Fruitland Park, Florida's finest lake-jeweled highland section, way above sea level. A few dollars a month will buy it. Plant peaches, a quick money crop, with oranges, and the peaches may be made to pay not only for your land and orange grove but yield a profit besides. We can produce you a better orange grove for less money than anyone in the State and in Florida's greatest section. Fruitland Park is best. We can prove it. Write for a book of actual photographs, the interesting story of a Fruitland Park farm and why peaches may pay for it. Lake County Land Owners' Association, 205 Palm Ave., Fruitland Park, Lake County, Florida.

SHAWNEE, Oklahoma—Center of a great farming country; write for free agricultural booklet. Board of Commerce, Shawnee, Oklahoma.

MONEY-MAKING farms—33 States—$10 to $100 acre. Stock, tools, crops often included to settle quickly. Write for big illustrated catalogue. Strout Farm Agency, 150 BH, Nassau Street, New York.

RICH hardwood land in Michigan. Grains, poultry, fruit, stock. Big yields. 10 to 160 acres. $15 to $35 per acre. Easy payments. Big booklet free. Swigart Land Company, G1251 First National Bank Bldg., Chicago, Illinois.

BOOKS AND PERIODICALS

"HOW to use Cement for Concrete Construction for Town and Farm." A book that shows how to build concrete structures. Equally valuable to builders, manual training schools and libraries. By H. Colin Campbell, expert engineer and director of the Editorial and Advertising Bureau, Portland Cement Association. 380 pages, 250 illustrations. Cloth bound. Price $2.00. Stanton and Van Vliet Company, Dept. B, 501-509 Plymouth Place, Chicago, Illinois.

HOW to Thought Read. Mind-reading at any distance. Both secrets 20c. Catalog free. The Midland Company, A539 East 149th St., New York.

MECHANICAL, Scientific Books, covering every trade. Also business. 6c stamps for complete catalogues appreciated. Satisfaction Guaranteed. Howard Co., Dept. 88, 702 West 181st St., New York.

"CONCORDIA" contains essays, short stories, current events, formulas, plans. Two years' subscription, 50 cents; one, 25 cents. Concordia Magazine, 11 Water, York, Pennsylvania.

BOOKS, Science, Literature, etc. Lists. Higene's, K2441 Post Street, San Francisco.

INSTRUCTION Book (for shop use) on Vulcanizing Auto-Tires, $1. Tire Equipment Company, 19 Canal, Cincinnati, Ohio.

BLUEPRINTS: How to read. See page 9. Mechanics' Improvement Association.

100,000 USED books for sale, 35c up. Some cost $10.00 new; History, Scientific, Technical, Science, etc. Catalogues 10c. McCarthy, 1061 West Van Buren Street, Chicago, Illinois.

FOR MEN AND WOMEN

MEN or Women—Enormous Profits Selling Duo Guaranteed Products. Easy sales at every house. All or spare time. Outfit free. Write quick. Duo Company, Dept. H66, Attica, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

"FORTY Ways to Make Money" 20 for Ladies—20 for Men. And "How to Write Scenarios." All for $1. Reinhart System, 747 East Jefferson St., Los Angeles, California.

WOODEN CARDS—Very interesting. 25 printed in your name 25c. X-Ray Optical Puzzle, 10c. Hough Company, Box 1013, Lowville, New York.

GENUINE Indian Baskets—Wholesale. Catalogue. Gilham, Highland Spring, California.

"SEXUAL Philosophy," 12c. Clear, specific, authoritative, complete, best, satisfies. Fred B. Kaessmann, Lawrence, Mass.

MAKE $19.00 Hundred Stamping Names on Key checks. Send 25c for sample and instructions. PS Keytag Company, Cohoes, New York.

BLUEPRINTS: How to read. See page 9. Mechanics' Improvement Association.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MEN. Intensely interesting booklet free. Wonderful results. Winslow E. Chase, Washington, D. C.

COLD-PROOF your head! Insure your nostrils and throat against catching cold by simply syringing same at intervals (through an atomizer) with a solution of "Ozeno" Antiseptic Powder, 30c bottle, at druggists or direct from The Ozeno Company, 240 Broadway, New York City. (State and foreign agencies available.)

DETECTIVES—Great demand, excellent opportunity. Experience unnecessary. Write American Detective System, 1968 Broadway, New York.

SHAMPU-TABS: Three Suddy Shampoos, 15c.; 2 for 25c. Tab Products, Dept. I, Farmingdale, New York.

FOR INVENTORS

900 Mechanical Movements, also illustrations explaining 50 Perpetual Motions. My book, Inventor's Universal Educator, Fifth Edition, tells how to procure and sell patents. Government and other costs. Covers the matter from A to Z. 160 pages elegantly bound. Contains noted decisions of U. S. Supreme and State Courts on Patent Cases. Mechanical Movements greatly assist inventors—suggest new ideas that may prove of great aid in perfecting inventions. Tells how to select an Attorney. Has valuable information regarding Patent Sharks, Selling Agents and Brokers. Price $2. Postage Free everywhere. Fred G. Dieterich, 681 Ouray Building, Washington, D. C.

BLUEPRINTS: How to read. See page 9. Mechanics' Improvement Association.

PATENTS—Write for free Guide Book and Evidence of Conception Blank. Send model or sketch of invention for free opinion of its patentable nature. Highest references. Reasonable terms. Victor J. Evans & Company, 156 Ninth, Washington, D. C.

PATENTS—My fee payable in monthly instalments. Send sketch for advice. Booklet free. Frank Fuller, Washington, D. C.

INVENTORS: We make models, dies, tools. 28 years' experience; work guaranteed; lowest price. Manufacture of specialties our hobby. Peerless Die & Tool Company, 121 Opera Place, Cincinnati, Ohio.

PATENTS—Send for free book. Contains valuable information for inventors. Send sketch of your invention for Free Opinion of its patentable nature. Prompt service. (Twenty years experience.) Talbert & Talbert, 4691 Talbert Building, Washington, D. C.

PATENT ATTORNEYS

PATENTS. If you have an invention which you wish to patent you can write fully and freely to Munn & Co., for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation. All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our handbook on Patents is sent free on request. This explains our methods, terms, etc., in regard to Patents, Trade Marks, Foreign Patents, etc., "Scientific American" contains Patent Office Notes. Decisions of interest to investors—and particulars of recently patented inventions. Munn & Co., Solicitors of Patents, 624 Woolworth Building, New York, and 625 F Street, Washington, D. C.; Tower Building, Chicago, Illinois; Hobart Building, 528 Market Street, San Francisco, California.

PATENTS—Herbert Jenner, Patent Attorney and Mechanical Expert, 622 F Street, Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS, trade-mark, copyright. Charges very reasonable. Metzger, Washington, D. C.

PATENTS Promptly procured—Personal, careful and efficient service. Highest references. Moderate fees. Send sketch or model for actual search and advice. George P. Kimmel, Master of Patent Law, 38-H Loan & Trust Building, Washington, D. C.

SUCCEED inventing. Brilliant book How to Finance Inventions, 242 pages sent $2 postpaid. Author will patent and manage your invention. Attorney Badt, Worcester, Massachusetts.

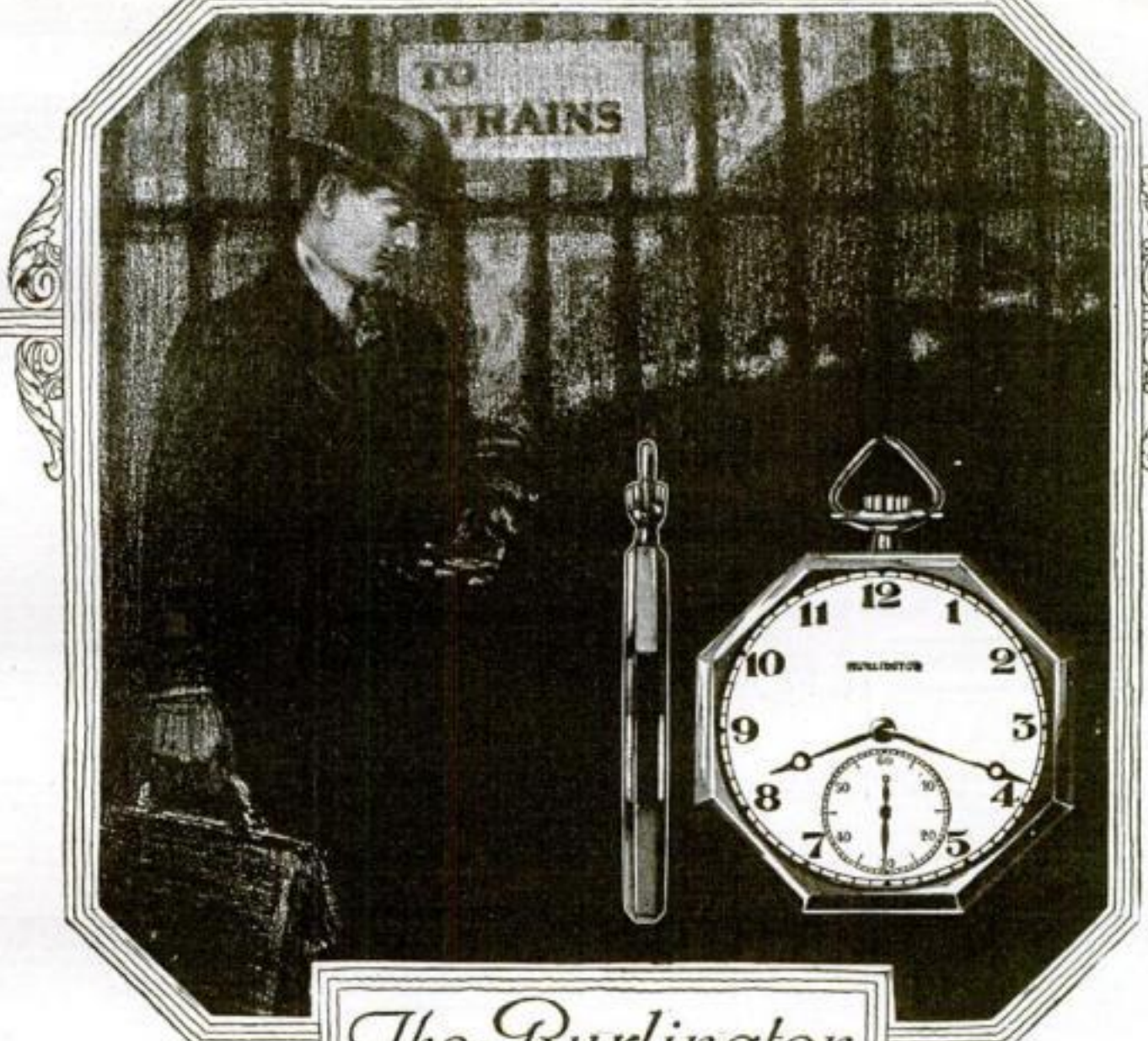
PATENTS—Send for free book. Contains valuable information for inventors. Send sketch of your invention for Free Opinion of its patentable nature. Prompt service. (Twenty years experience.) Talbert & Talbert, 4624 Talbert Building, Washington, D. C.

GET your own patents. Save attorney's fees; instructions and advice free. Carl Larsen, Park Row Building, New York.

PATENTS: In all matters pertaining to invention consult National Institute of Inventors, 118 Fulton, New York City, having three thousand members. Booklet free.

PATENTS!—The Expert Personal Service of this firm is of great importance to you in properly protecting your invention by patent. (Est. 1897.) Write to John B. Thomas & Co., 902 F Street, N. W., Washington, D. C.

Quick-Action Advertisements continued on page 12



The Burlington

21 Jewels-Rubies and Saphires

Adjusted to the Second - Adjusted to Temperature - Adjusted to Isochronism - Adjusted to Positions
25-Year Gold-Strata Case - Genuine Montgomery Railroad Dial - New Art Designs - Extra Thin Cases

Only $3.50 a Month

YOU pay only this small amount each month for this masterpiece, sold to you at the direct rock-bottom price, the lowest price at which a Burlington is sold. This masterpiece of watch manufacture is adjusted to position, adjusted to temperature, and adjusted to isochronism. Send the coupon today for free book on watches.

Send the Coupon

You do not pay a cent until you see the watch. Send the coupon today for this great book on watches, and full information of the $3.50 a month offer on the Burlington Watch. Don't delay. Act right NOW!

Burlington Watch Co., 19th St. and Marshall Blvd., Chicago, Ill.

Burlington Watch Co., *Dept. B-136 19th Street and Marshall Boulevard* **Chicago**
338 Portage Avenue, Winnipeg, Manitoba

Please send me (without obligation and prepaid) your free book on watches with full explanation of your cash or $3.50 a month offer on the Burlington Watch.

Name.....

Address.....

.....

PATENTS, prompt, personal, efficient service by an Attorney-at-law skilled in all branches of Patent practice. Over 12 years' actual experience. Full information on request. B. P. Fishburne, 323 McGill Building, Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C.

PATENTS—Fees in installments. Frank T. Fuller, formerly Lieutenant, Engineers, Washington, D. C.

INVENTIONS patented trade-marks registered: labels, prints, publications copyrighted; prompt service; reasonable fees; plain advice; request detailed information before placing your business. Jaynes & Jaynes, 801 Kellogg, Washington, D. C.

PATENT applications filed on partial payment plan. Trade-marks, copyrights, etc. Milo B. Stevens & Company, 640 F Street, Washington. Established 1864.

PATENT Attorney. Consulting Engineer, high-class Patent Service in all its branches. Write for particulars. M. H. Loughridge, 1457 Broadway, New York.

PATENTS—Write for free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for free opinion of its patentable nature. Highest References. Prompt attention. Reasonable terms. Victor J. Evans & Company, 155 Ninth, Washington, D.C.

ALEXANDER CURRIE 21 years patent and mechanical experience, special care on rough sketches or models to have patent drawings show complete workmanlike construction; advice free. 150 Nassau Street, New York.

"INVENTORS' Record" and "Bulletin" sent without charge. My free blank form for disclosing your invention simplifies procedure. Send sketch or description for preliminary advice. Wm. H. Mulligan Registered Attorney, 396 Woodward Building, Washington, D. C.

"INVENTORS Adviser" sent free on request. William C. Linton, 918 F Street, N. W., Washington, D. C. 362 University Street, Montreal, Canada.

INVENTORS—My clients know every step taken in prosecuting their applications. Booklet sent free on request. Warner Cubberley, 20 National Union Building, Washington, D. C.

LACEY Patent-Sense. "The book the inventor keeps." Free. See page 129.

PATENTS, Trade Marks, Copyrights. Prompt, personal, reliable service. Over 30 years' active practice. Write for terms. Book free. Address E. G. Siggers, Box 1, N. U. Building, Washington, D. C.

PROTECT your rights. Write for "Record of Invention," which contains forms to establish evidence of conception of your invention. Prompt personal service. Preliminary advice without charge. J. Reaney Kelly, 732 Woodward Building, Washington, D. C.

INVENTIONS Patented; honest and reliable service; send for free booklet of information. Frank Ledermann, 15 Park Row, New York.

INVENTORS, send sketch or model of your inventions for opinion concerning patentable nature and exact cost of applying for patent. Book, "How to Obtain a Patent," sent free. Gives information on patent procedure and tells what every inventor should know. Established twenty-five years. Chandlee & Chandlee, 412 Seventh Street, N. W., Washington, D. C.

M. E. MILLER, Ouray Building, Washington, D. C., patent attorney, mechanical and electrical expert. Best quality of work and results. Moderate charges. Advice free.

DON'T lose your rights to patent protection. Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster & Allwine, 232 Ouray Building, Washington, D. C., Originators of the form "Evidence of Conception."

PATENTS procured—trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C., or 2276-Z Woolworth Building, New York.

AGENTS AND SALESMEN WANTED

TAILORING Agents Wanted—Big complete sample outfit and case, nearly 200 large cloth samples, 3-price lists and everything needed for canvassing, or use in store, free to live agents. $25.00 to $50.00 a week; may make more. Write us to-day for free elegant outfit to begin, cloth samples, wholesale prices, special offer on a suit for yourself and full information. See our wonderful value, beautiful fabrics and styles. Established 28 years. Every garment made to measure—everything guaranteed and express prepaid. Just send a postal. American Woolen Mills Company, Dept. 1407, Chicago.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Company, Dept. 467, Amsterdam, New York.

WORLD'S Greatest Auto Invention; no more blurred windshields; chemical felt works wonders; one rub keeps glass clear 24 hours; steel mountings; fits pocket; sells $1.00; Vetter made $75 first day. Security Mfg. Company, 288, Toledo, Ohio.

$40 to $100 a week. Free samples. Gold sign letters anyone can put on windows. Big demand. Liberal offer to general agents. Metallic Letter Company, 431A North Clark, Chicago.

AGENTS—Something different. Our Eradium (Luminous) Crucifix, actually shines in the dark. Startling! Mysterious! Wonderful! Enthusiasm follows every demonstration. 150% profit on every sale. Sole manufacturers. The Pioneer Corporation, 1203 West 63rd Street, Chicago, Illinois.

PORTRAIT agents—Send at once for new 1920 Catalog of Picture Frames and Enlargements. Save money on your frame purchases. Send us your portraits for enlargement and get the best work and service in the country. W. G. Hannan Co., Dept. A-15, 57 East 18th Street, Chicago.

WONDERFUL New Chemical. $1.00 Package equal 50 gallons gasoline. Eliminates carbon. 50% more mileage, power, speed. Guaranteed. Whirlwind seller. Auto owners buy on sight. 100% profit. Repeater. Demonstrating package, terms, territory, 10c postage. Myers & Company, 36 Baird, Cambridge, Ohio.

IDEAL Sideline. Business men buy on sight. $1.00 seller, 400% profit. N. Home, 1957 Warren, Chicago.

WONDERFUL chance! Men's shirts and furnishings at wholesale rates, or make $10 daily starting real business. Goodell Company, 87 Duratex Building, New York.

MEN and Women—Become independent—own your business, experience unnecessary selling our $6,000 Accidental Death, $30.00 Accident, $25.00 Sick Weekly Benefits, $10.50 yearly, half amounts $5.50. Guaranteed steady income from renewals. $250,000 deposited Insurance Department. Registration Dept. S, Newark, N. J.

VULCANIZING Auto Tires growing and profitable business, especially now. Easy to learn. Instruction book $1. Plants $50 up. Catalog free. Equipment Company, 149 Canal, Cincinnati, Ohio.

MAKE and Sell Your Own Goods. Machinery unnecessary. Expert Chemists advice. Special attention to beginners. Write for Formula Catalog, Elmer Mystic Company, Washington, D. C.

SALESMEN wanted to sell Electric Cigar Lighters and Moisteners. Salary or Commission. You carry stock or we ship direct. Write for Special Offer. Drake Manufacturing Company, 220 Grand, Milwaukee, Wisconsin.

WANTED: Man with auto in every section to sell our Big Six-In-One tool, comprising vise, pipe vise, anvil, drill press, cutting hardie and corundum grinder. Every farmer, janitor, private or public garage, small shop, etc., a prospective buyer. Outfit weighs 90 pounds, sells for $24.00 with a fat profit to you. No trick to sell. Always pleases. Write Chicago Flexible Shaft Company, Dept. H. W, 5600 West 12th Street, Chicago.

AGENTS—Make $50 weekly taking orders for fast selling Goodyear raincoats; hundreds of orders waiting; $2 an hour for spare time; we deliver and collect; sample coat free; write today for agency. Goodyear Mfg. Company, B136 Goodyear Building, Kansas City, Missouri.

FREE—Latest issue. New Formulas. Tells how to make your own goods. Write today. S. & H. Manufacturing Laboratories, 10602, Boylston Building, Chicago.

AGENTS—Jobbers, Catchiest Novelty Invented! Aerial Balloon makes youngsters wild with joy. Immensely interesting. Season's sensational seller. Large profit. No competition. Write immediately. Marui & Company, Tribune Building, New York.

AGENTS—$10-$15 daily. Every owner wants his gold initials on side door of automobile; applied while waiting; sale, $1.50; profit, $1.38. Write for general agency, our special offers and free samples. Monogram Supply Company, Dept. C, Bowers Building, Newark, New Jersey.

AGENTS and General Agents—Make traveling a profit instead of a loss. Go from town to town selling household necessities and securing new agents. Big income on your own and your agents' work. Write quick. Duo Company, Dept. B16, Attica, New York.

THE prosperous agent is a Davis agent. Line up for the Big Rush—$40-$60 weekly. "Lucky 11" and our 27 other varieties cut store price 1-3-½. Worth 150% to 200% for you. Davis Products Company, Dept. 51, Chicago.

$732.25 earned January by one man; others made $200.00 to $500.00 same month. With auto season just ahead our agents will double—triple this. You can do the same, selling this wonderful new invention—guaranteed to prevent punctures and lessen cost per mile of tire. Dept. K, Tire In-Sole Mfg. Company, Findlay, Ohio.

BIG Money and Fast Sales. Every owner buys Gold Initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Company, Dept. 47 East Orange, New Jersey.

SIGN Agents to represent us in your locality; unlimited field. Samples free. Interstate Sign Company, Dept. A, 2620 North Halstead Street, Chicago.

STOP! Read twice! "Everybody's Friend" offers 200% profit, money back for failure to remove grease spots from clothes and exclusive territory. 25c coin brings pack ge. Write to day. Anson E. Palmer, 1,615 Race Street, Ph ladelphia, Pennsylvania.

MAKE $30.00 next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Company, 1049 Hayward Building, Detroit, Michigan.

SELL Tires direct to car owner. 30x3 non-skid $11.75. Tubes $2.25; other sizes in proportion. Guaranteed 6,000 miles on liberal adjustment basis. Big commissions paid weekly. Experience or capital unnecessary. Auto Tire Clearing House, 1572 West 15th, Chicago, Illinois.

SEND for free catalogue "Golden Opportunities" Typewritten formulas, trade secrets in every line, chemical analysis. 23 years manufacturing experience. No humbuggery. Satisfaction guaranteed. Industrial Sales Service, 73 Washington, Memphis, Tennessee.

$1,000 per Man per County; Strange invention startles world—agents amazed. Ten inexperienced men divide $40,000. Korstad, a farmer, did $2,200 in 14 days. Sletcher, a minister, $195 first 12 hours. $1,200 cold cash, made, paid, banked by Stoneman, in 30 days; $15,000 to date. A hot or cold running water bath, equipped for any home at only $6.50. Self-heating. No plumbing or water-works required. Investigate. Exclusive sale. Credit given. Send no money. Write letter or postal to-day. Allen Mfg. Co., 541 Allen Building, Toledo, Ohio.

$75.00 weekly selling Liberty-Blue Ink Powder. Enthusiastic Agents Everywhere. Sample and attractive proposition free. Norman Ord. Hemet, California.

MAN in each town to refinish chandeliers, brass beds, automobiles, by new method. $10 daily without capital or experience. Write Gunmetal Company, Avenue "F," Decatur, Ill.

PATENTS. Write for Free Illustrated Guide Book. Send sketch or model for free opinion of its patentable nature. Highest references. Prompt attention. Reasonable Terms. Victor J. Evans & Co., 174 Ninth, Washington, D. C.

SALESMEN, high grade, for state and county agencies; practical device rings electric bells forever without batteries; made by leading manufacturer. Sound, permanent business; men are already making good money; territory being rapidly assigned; references and previous experience essential. Betts & Betts Corporation, Betts Building, 42nd Street, New York.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalbrite Company, 1115 Second Avenue, New York.

SALESMEN—City or travelling. Experience unnecessary. Send for list of lines and full particulars. Prepare in spare time to earn the big salaries—$2,500 to 10,000 a year. Employment services rendered members. National Salesmen's Training Association, Dept. 126H, Chicago, Illinois.

WONDERFUL Adding Machine—Seven column capacity—retails for one dollar. Sells itself everywhere. Most offices purchase several. Sensational agency proposition. L. J. Leishman Co., Dept. F, Ogden, Utah.

AGENTS: Sell rich looking 36x38 imported rugs, $1.00 each. Carter, Tenn., sold 115 in 4 days; profit, $57. You can do same. Write for sample offer and selling plan; exclusive territory. Sample rug by parcel post prepaid, $1.39. E. Condon, Importer, 12 Pearl Street, Boston, Massachusetts.

AGENTS make 500% profit handling auto monograms, new patriotic pictures, window letters, transfer flags and novelty signs. Catalog free. Hinton Company, Star City, Indiana.

SALESMEN—$10-$15 daily selling gold transfer letters for autos to supply stores, garages, etc. Send for free samples; general agency given. Transfer Supply Company, Bowers Building, Newark, New Jersey.

WE want live representatives in your locality selling Bull Dog Inner Tires. Inner casing for automobile tires. Guaranteed to prevent punctures and blow-outs, tire fabric not canvas. Double tire mileage. Easy to sell. Big demand. Protected territory. Agents making $150.00 weekly. Eastern Auto Specialty Company, Dept. B., Utica, New York.

AGENT Johnson made $10.00 first evening. Particulars, "Taymor," W-335 Broadway, New York.

WERE you ever offered a grocery store? You can handle Sugar, Flour, Canned Goods, Dried Fruit, Coffee and entire line of Groceries, as well as Paints, Roofing, Aluminum Ware and Automobile Oils, with no rent to pay; no money invested; take large orders from samples. Goods are guaranteed and proven quality. Selling experience not necessary. Steady, profitable work for "workers." Address Hitchcock-Hill Company, Dept. 220, Chicago, Illinois. Reference: any Bank or Express Company.

KEROSENE Burners for Furnaces, Cook and Heating Stoves. Economy Mfg. Company, 616 West Monroe, Chicago.

SANITARY Wire-Grip Brushes, Dustless Mops, Dustless Furniture Dusters, Automobile Brushes, etc., are the big money-makers of the year. Exclusive territory for live salespeople. North Ridge Brush Co., 115 Clark Street, Freeport, Illinois.

$5.00 to $25.00-daily monogramming automobiles, etc., with Globe Transfer Initials. Particulars free; samples 10c. Globe Decalcomania Company (Factory), Newark, New Jersey. West of Rockies, 1765 Green Street, San Francisco.

AGENTS—Steady Income. Large manufacturer of Handkerchiefs and Dress Goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Whole or spare time. Credit given. Send for particulars. Freeport Mfg. Company, 24 Main Street, Brooklyn, N. Y.

BIG profits selling Jubilee Spark Intensifier to auto owners, garages. Banishes spark plug trouble. Saves gas. Exclusive territory. Jubilee Mfg. Co., 94 Sta. C, Omaha, Nebraska.

AGENTS and Crew Managers: New fast selling food specialty. Livest article. Packed your label. Write or wire. Federal Pure Food Company, 2305-H Archer Avenue, Chicago.

GET our plan for monogramming automobiles, trucks, hand luggage and all similar articles by transfer method; experience unnecessary; exceptional profits. Motorists Accessories Company, Mansfield, Ohio.

INSYDE Tyres, inner armor for Automobile Tires, prevent punctures and double mileage of any tire. Liberal profits. Details free. American Accessories Co., Dept. 97, Cincinnati, Ohio.

WHISKEY, Brandy, Rum, Champaigne, Wines, 50 Other Non-Alcoholic Flavors for Soda Fountain foods, etc. Out-selling all others on the market. One salesman sold over a thousand dollars worth in one week. Write today for particulars and proof. Make these goods yourself, get exclusive territory now. Crouch, Chemist, 309 Broadway, New York.

500 Agents wanted at once for Mitchell's Magic Marvel Washing Compound. 300% profit, enormous repeater. Washes clothes spotlessly clean in ten to fifteen minutes. One thousand other uses in every home. Astounds and delights every woman. Nothing else like it. Nature's mightiest cleanser. Contains no lye, lime, acid, or wax. Free samples furnished to boost sales. We positively guarantee the sale of every package. Exclusive territory. Own your own business. You cannot fail to make big money. Barber, Ohio, made $600 last month. Send for free sample and proof. Hurry, hustle, grab this chance. L. Mitchell & Company, Desk 301, 1312-1314 East 61st, Chicago.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared $800 in July. Send for sample. It's free. Nichols Company, Box 1B, Napierville, Illinois.

AUTOMATIC Sleeve Links Cuffs over Elbows instantly without bother. Lowered they close automatically. Sell like wildfire. Great convenience and shirt saver. Liberal exclusive proposition for experienced salespeople. Sample pair, $1.00. Expandolinks Manufacturers, Sheboygan, Wisconsin.

"ONE Raindrop" Window Operator; windows shut automatically. Sample postpaid, $1.00. Automatic Window Company, 2107 North Percy, Philadelphia.

ONE sale a day means $200 per month. Five a day—$1,000 per month. Marvelous new Automatic Adding Machine, retails $12.50. Work equals $300 machine. Five-year guarantee. Write quick for protected territory and trial offer. Calculator Corporation, Dept. O, Grand Rapids, Michigan.

SELL "Victorclean" Washing Wonder. It's a wonderful repeater. Free samples to boost sales. Skytt, 725 East 5th, Duluth, Minnesota.

EASY, pleasant work for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Company, 27 Bar Street, Canton, Ohio.

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent.; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

AGENTS—Sell Laundry Tablets under your own name and brand. Free samples and circulars furnished with every order. Particulars free; samples fifteen cents. Krebs E. Products, College Point, New York.

DROP everything else. Sell guaranteed silk hosiery and underwear all or spare time; direct from factory to consumer. Big money maker. Big commissions. Prompt deliveries. C. & D. Company, Dept. 10, Grand Rapids, Michigan.

AGENTS, big profits selling famous Keen-O Polish and Rug Cleaner. Something new, samples and particulars 35c. Keen-O Polish Company, 1605 Prairie Avenue, Kenosha, Wisconsin.

SIGNS for store and offices. Entirely new. $50 week easily made. Chicago Sign System, T-326 River Street, Chicago.

AGENTS' directory—Listing over 1,000 rapid selling agent specialties with first hand sources of supply; 128 pages, 1920 edition; postpaid 25c. Swanson, 12058 Kansas Avenue, Kansas City, Kansas.

"FLOWER Bead Necklaces" fast sellers, want agents every state. Wood Bead Company, 230 East 30th Street Los Angeles.

LYNER TYRES, "form-fit," inside tire protectors. Guaranteed against blowouts and most punctures. Easily installed. Wonderful opportunity to establish permanent business. Protected territory. Interesting pamphlet free. Pelletire Rubber Company, Box 322, Cincinnati, Ohio.

AGENTS: Sell our accident and sickness policies in your spare time. Pay $5000 death, $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commissions. Insurance Company, Dept. J-1, Newark, New Jersey.

Copy this Sketch

and let me see what you can do with it. Many newspaper artists earning $30.00 to $125.00 or more per week were trained by my course of personal individual lessons by mail. PICTURE CHARTS make original drawing easy to learn. Send sketch of Uncle Sam with 6c in stamps for sample Picture Chart, list of successful students, examples of their work and evidence of what YOU can accomplish. *Please state your age.*

The Landon School
of CARTOONING and ILLUSTRATING
1251 Schofield Bldg. Cleveland, Ohio

Free to Writers!

A WONDERFUL BOOK—read about it. Tells how easily Stories and Plays are conceived, written, perfected, sold. How many who don't DREAM they can write, suddenly find it out. How the Scenario Kings and the Story Queens live and work. How bright men and women, without any special experience, learn to their own amazement that their simplest Ideas may furnish brilliant plots for Plays and Stories. How one's own Imagination may provide an endless gold-mine of Ideas that bring Happy Success and Handsome Cash Royalties. How new writers get their names into print. How to tell if you ARE a writer. How to develop your "story fancy," weave clever word-pictures and unique, thrilling, realistic plots. How your friends may be your worst judges. How to avoid discouragement and the pitfalls of Failure. HOW TO WIN! This surprising book called "*The Wonder Book for Writers*," is ABSOLUTELY FREE. No charge. No obligation. YOUR copy is waiting for you. Write for it NOW. Just address

AUTHORS' PRESS, Dept. 123, AUBURN, NEW YORK

Learn Electricity IN 3½ MONTHS

No need of taking from 1 to 4 years at America's greatest practical institution. Finest equipment. No books. No classes. All individual instruction. No special education necessary. Day and evening school. Open all year. Enter any time. Earn while you learn. Also courses in Drafting, Plumbing and Motion Picture Operating.

Send for free book now. Be sure to state which course interests you.

COYNE TRADE AND ENGINEERING SCHOOL
Dept. 37 39-51 E. Illinois St., Chicago, Ill

Electrical Engineering In One Year

men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920.

BLISS ELECTRICAL SCHOOL 102 Takoma Ave., Washington, D. C.

Learn to Write

Begin Today-Write for My FREE BOOK

I can make a good penman of you at home during spare time. Write for my FREE BOOK, "HOW TO BECOME A GOOD PENMAN." It contains specimens and tells how others mastered penmanship by the Tamblyn System. Your name will be elegantly written on a card if you enclose stamp to pay postage. FREE BOOK—Write for it Today.

F. W. Tamblyn, 437 Ridge Bldg., Kansas City, U.S.A.

STAMMER

If you stammer attend no stammering school till you get my big new FREE book and special rate. Largest and most successful school in the world, curing all forms of defective speech by **advanced, natural method. No sing-song, hand-swing or time-beat.**

North-Western School for Stammerers, Inc.
2335 Grand Avenue Milwaukee, Wis.

I TEACH Penmanship BY MAIL

I won World's First Prize for best course in Penmanship. Under my guidance you can become an expert penman. Am placing many of my students as instructors in commercial colleges at high salaries. If you wish to become a better penman, write me. I will send you FREE one of my **Favorite Pens** and a copy of the Ransomerian Journal. Write today.

C. W. RANSOM, 488 Essex Bldg., Kansas City, Mo.

BE AN EXPERT

Auto and Tractor Mechanic
Earn $100 to $400 a Month

Young man, are you mechanically inclined? Come to the Sweeney School. Learn to be an expert. I teach with tools not books. Do the work yourself, that's the secret of the

SWEENEY SYSTEM

of practical training by which 5,000 soldiers were trained for U. S. Government and over 20,000 expert mechanics. Learn in a few weeks; no previous experience necessary.

FREE Write today for illustrated free catalog showing hundreds of pictures men working in new Million Dollar Trade School.

LEARN A TRADE
Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
42 SWEENEY BLDG. KANSAS CITY, MO.

DO YOU LIKE TO DRAW

Cartoonists Are Well Paid

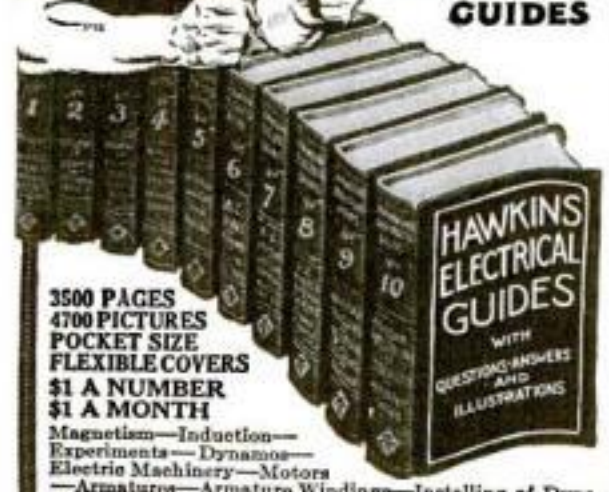
We will not give you any grand prize if you answer this ad. Nor will we claim to make you rich in a week. But if you are anxious to develop your talent with a successful cartoonist, so you can make money, send a copy of this picture with 6c in stamps for portfolio of cartoons and sample lesson plate, and let us explain.

THE W. L. EVANS School of Cartooning
825 Leader Bldg., Cleveland, O.

Get Bigger Pay through ELECTRICITY

You will find in HAWKINS GUIDES just what you need to know about electricity. In simple everyday language—complete, concise, to the point. In questions and answers. A complete standard course in Electrical Engineering. Send for your set today to look over.

HAWKINS ELECTRICAL GUIDES



3500 PAGES
4700 PICTURES
POCKET SIZE
FLEXIBLE COVERS
$1 A NUMBER
$1 A MONTH

Magnetism—Induction—Experiments—Dynamos—Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamos—Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems—Wiring—Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors—Transformers—Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switch Boards—Power Stations—Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many modern Practical Applications of Electricity and Ready Reference Index of the 10 numbers.

Shipped to you FREE. Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send coupon now—today—and get this great help library and see if it is not worth $100 to you—you pay $1.00 a month for 10 months or return it.

SEND NO MONEY

THEO. AUDEL & CO., 72 Fifth Ave., N. Y. Please submit for examination **Hawkins Electrical Guides** (Price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory, I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature_____
Occupation_____
Employed by_____
Residence_____
Reference_____ P.S.M. 7-20

BECOME AN EXPERT ACCOUNTANT

The Profession That Pays Big Incomes

Never before have there been so many splendid opportunities for trained accountants—men whose training combines a knowledge of Auditing, Cost Accounting, Business Law, Organization, Income Tax Work, Management and Finance. Few professions offer better opportunities to young men of ambition and intelligence. The tremendous business growth of this country has created a rich field for the expert. There are only about 3,000 Certified Public Accountants to do the work of the half million concerns needing proficient accounting service. The expert accountant is needed today in every big business organization.

Knowledge of Bookkeeping Unnecessary to Begin

If you are ambitious, you can train for one of these big positions. The LaSalle method will train you by mail under the direct supervision of William B. Castenholz, A. M., C. P. A., former Comptroller and Instructor, University of Illinois, assisted by a large staff of Certified Public Accountants including members of the American Institute of Accountants. You will be given whatever training, instruction or review on the subject of bookkeeping you may personally need—and without any expense to you. Our big free book on the accountancy profession fully explains how we train you from the ground up, according to your individual needs, from the simplest bookkeeping principles to the most advanced accounting problems. All text material supplied in the course has been especially prepared in clear, easy-to-understand language so that you can readily master the principles by home study.

Send for the Facts Now

Mail the coupon now and get our free book which fully describes our expert training course and tells all about our Money-Back Guarantee, C. P. A. examinations, state regulations, salaries and incomes, and how you can qualify for a high-grade accounting position without interference with your present position. Send in the coupon and find out how we have helped over 215,000 ambitious men, and learn what we can do for you.

Valuable Book FREE

A prominent Chicago executive says: "Get this book, 'Ten Years' Promotion In One,' even if it costs you $5.00 for a copy." Let us send it to you **free,** with literature explaining how you can train for a Higher Accountancy job without interference with your present duties.

Send coupon today—NOW.

— — — Mail This Coupon — — —

LASALLE EXTENSION UNIVERSITY
The Largest Business Training Institution in the World
Dept. 783-H **Chicago, Illinois**

Send at once, without cost or obligation to me, your valuable book, "Ten Years' Promotion In One," also your book of Accountancy Facts and full details of your course in Higher Accounting.

Name_____
Present Position_____
Address_____

U. S. Player Music Rolls are nationally known and advertised; more than five thousand piano and phonograph dealers handle them. We want representatives to become our dealers where we have no regular dealer distribution. No experience nor investment required to earn big profits and establish yourself in business. All player piano owners are constant buyers of music rolls. 80% of all pianos sold are player pianos. Applications desired from honest and energetic people wishing a steady income. United States Music Company, 2933 West Lake Street, Chicago, U. S. A.

DOUBLE your income every week; nature does it while you sleep. Self-addressed envelope for report. V. B. Company, Pearl River, New York.

RADIUM Pepolites shine in the dark. Guaranteed five years. Used to locate anything in the dark. Send 15c stamps for sample. Agents 100% profit. Radium Sales Company, Weehawken P. O., New Jersey.

AGENTS—Cash in on prohibition. $37 to $46 weekly. New, fast selling articles—going like wildfire. Agents cleaning up. Write today for particulars. American Products Co., 2352 American Bldg., Cincinnati, Ohio.

REPRESENTATIVE Wanted to handle our complete line of fire protection devices, such as Ajax chemical fire engines on wheels, hand fire extinguishers, fire buckets and tanks, hose carts, racks, reels and hose, watchmen's clocks, ladders, escapes, signs, etc. Every factory, mill, store, fire department, etc., is in the market for our extensive line. Representative wanted capable of earning $5000 upwards, annually. Ajax Fire Engine Works, Bush Terminal Building, Brooklyn, New York.

SALESMAN—Side or main line, to sell low-priced 6,000 mile guaranteed automobile tires, 30x3½ non-skid sells for $13.95; other sizes in proportion. Good money-making proposition for live wires. Master Tire Co., 1414 South Michigan, Chicago.

AGENTS wanted to sell our 25 light acetylene gas generator; fully guaranteed; cheap; safe and reliable. Write Daniel Zimmerman, Magley, Indiana.

$10 WORTH of finest toilet soaps, perfumes, toilet waters, spices, etc., absolutely free to agents on our refund plan. Lacassian Co., Dept. 615, St. Louis, Missouri.

WATER stills, made entirely of heavy copper, one or three gallon capacity, prices $25.00 and $40.00, respectively. Shipped prepaid by express or parcel post the same day we receive your order. Ideal for distilling water for automobile batteries, industrial uses, and drinking purposes. Boyer & Company, 802 Farham Building, Omaha, Nebraska.

AGENTS wanted for automobile specialties, three big sellers, patented, big profit, no competition, every owner a prospect. Rubber Steering Grips, Lubricators, Lamp Brackets and others. Fracto Specialty Co., Manufacturers, 161 Massachusetts Avenue, Boston, Massachusetts.

AGENTS: Waterproof Kitchen Apron. Needs no laundering. Every housewife buys. Dainty, durable, economical. Big money. Sample free. Thomas Company, 2161 North Street, Dayton, Ohio.

MAKE big money manufacturing marble, onyx, tile more beautiful than genuine at cost of about 10c sq. ft. Marble face brick any color, $15 thousand—sell $75. Experience unnecessary. Money back guarantee with all expenses incurred if you cannot make products listed by following my instructions. Send for sample and list. R. F. Spencer, Box 213, Los Angeles, California.

HELP WANTED

BE a Finger Print Expert—$25 to $50 a week and more in this new and fascinating profession. Finger Print Experts hold positions of independence and trust. Work intensely interesting. They are in big demand by banks, corporations, big factories, detective agencies, etc. You can qualify. Write today for special limited offer and free illustrated Book. Tells all about Finger Prints. University of Applied Science, Room B186, 1920 Sunnyside Avenue, Chicago, Illinois.

GOVERNMENT positions are desirable. $1000-$2000 to start. Let our expert (Former Government Examiner) prepare you. Free booklet. Patterson Civil Service School, Box 5026, Rochester, New York.

DETECTIVES earn big money. Travel. Experience unnecessary. We train you. Particulars free. Write American Detective System, 1968 Broadway, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

BE a Mirror Expert, $3-$10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors, French method. Free prospectus. W. F. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

FIREMEN, Brakemen, Baggagemen, $140-$200, Colored Porters, by railroads everywhere. Experience unnecessary. 830 Railway Bureau, East St. Louis, Illinois.

SILVERING Mirrors. French plate taught. Easy to earn. Immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

DETECTIVES make big money. Be one! Excellent opportunities. Write American School of Criminology, Detroit, Michigan.

VULCANIZING auto tires growing and profitable business, especially now. Easy to learn. Instruction book $1. Plants $50 up. Catalogue free. Equipment Company, 21 Canal, Cincinnati, Ohio.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports. Salaries, expenses. American Foreign Detective Agency, 321, St. Louis.

WRITE Photoplays; $50 each. Experience unnecessary; details free to beginners. Producers' League, 194, St. Louis.

STOP daily grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 95, Marion, Indiana.

BLUEPRINTS: How to read. See page 9. Mechanics' Improvement Association.

DETECTIVES Earn Big Money. Travel, unusual opportunity. Write Johnson's Detective Correspondence School, Dept. H, 232 Sheldon Avenue, Grand Rapids, Michigan.

RAILWAY traffic inspectors earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Positions furnished under guarantee. Write for Booklet CM-13, Standard Business Training Institute, Buffalo, New York.

PATENTS—Book free. Send sketch for free opinion of patentable nature. Talbert & Talbert, 4846 Talbert Building, Washington, D. C.

BE prosperous. Painting portraits on glass; silvering mirrors; plating tableware; metal plating. Instructions complete $1.00. Send to-day. Address N. S. Rorick, Dept. B, 427 Carroll Street, Akron, Ohio.

LEARN to Write Advertisements. Unlimited demand for trained advertising men. Earn $60 to $150 a week. We teach you every angle of this highly paid profession in your spare time by mail. We help you to secure a position. Write for Free Book, "Increased Salaries and Promotion." Page-Davis Correspondence School, Dept. 1365, Chicago, Illinois.

MEN—Boys, 16 up. Get ready for railway mail clerk examinations. $100—$150 month. List positions obtainable free. Franklin Institute, Dept. T50, Rochester, New York.

BUSINESS OPPORTUNITIES

ENTER a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks, at small expense; no further capital required; no goods to buy, job hunting, soliciting or agency. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts.

WE start you in business, furnishing everything. Men and women, $30.00 to $100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime. Booklet free. H. Ragsdale Company, East Orange, New Jersey.

BUILD a genuine Choraleon Phonograph and save over half. Fine profits building and selling. We furnish motors, tone arms and necessary parts. Send for our catalog and Free blue print offer. Choraleon Phonograph Company, 723 Monger Building, Elkhart, Indiana.

BIG profits raising Belgian Hares. We pay you $6.00 pair and express. Contract, literature 10c. Co-operative Supply Company, Dept. K, St. Francis, Wisconsin.

SUBSTANTIAL manufacturing corporation wants capable man to establish branch and manage salesmen; $300 to $1,500 necessary; you handle own money; will allow expenses to Baltimore if you will qualify. For particulars address Secretary, 416 North Howard Street, Baltimore, Maryland.

CONTROL new exclusive phonograph record exchange business for your town. $25 capital required. Satco Science, Oneonta, New York.

BUILD up your own business. We will manufacture article in demand everywhere, retailing $1.50, under your label, at 30c each. We guarantee to teach you how to sell retail, wholesale, through agents, personally, and by mail free. Tremendous repeat business; one of our customers made $1000 one month. Write for proof. Scientific Laboratories, 27 Court Street, Brooklyn, New York.

HOME-WORK! Ten valuable Articles, instructions for making, how and where to sell them, only $1.00. Act now and succeed to-morrow. Home Aid Company, West Milan, New Hampshire.

RAISE Silver Foxes! Large profits. Easy to raise. Exceptional opportunity. New syndicate. Easy terms. Particulars free. C. T. Dryx, 5244-87 South Maplewood Avenue, Chicago.

TEN CENT package Metler's Compound makes one pint excellent ink. Sample 5 cents. A. D. Metler, Louis Street, New Brunswick, New Jersey.

STUDY Human Nature, make people like you, get along better, make more money, develop a winning personality, learn to know people as they are. Send 5 cents (stamps) for "Personal Power," a little book that points the way. Address, Progress League, 4431 Union Square, New York.

USED Correspondence Courses of all kinds sold. (Courses bought.) Lee Mountain, Pisgah, Alabama.

YOU can earn $50 to $150 a week as an Ad-Writer. Experience unnecessary. Particulars for stamp. R. P. Koehler, Dept. 60, 156 West Vernon, Los Angeles.

I MADE $30 a week evenings with a small mail-order business. Free Booklet tells how. 2c postage. Al Scott, Cohoes, New York.

MEN Wanted—Manufacturing concern wants men to open office and manage salesmen; wonderful opportunity to make big money; from $300 to $5000 necessary. Write Director of Sales, Connery Machine & Tool Company, Springfield, Mass.

START Business. Practical chemists will supply you with formulas, trade secrets, chemical information, manufacturing processes, analysis. Klonin & Company, 5169 Jefferson Street, Philadelphia, Pennsylvania.

PATENTS Procured—Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C.

EXPERT Chemist will furnish Formula and Trade Secrets in all lines. Lists free. W. L. Cummings, Ph.D., Gordon Avenue, Syracuse, New York.

VULCANIZING Auto Tires growing and profitable business, especially now. Easy to learn. Instruction Book $1. Plants $50 up. Catalogue free. Equipment Company, 151 Canal Street, Cincinnati, Ohio.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

DOLLARS yearly in your backyard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. C. Metz, 313 East 89th St., New York.

INSYDE tyres, inner armor for automobile tires, double mileage and prevent punctures and blowouts. Quickly applied. Cost little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 97B, Cincinnati, Ohio.

MAN or Woman, start anywhere; materials that cost equipment. Call or write for literature. Anderson Steam Vulcanizer Company, 2302 Grand Avenue, Kansas City, Missouri.

DO You know every move your attorney makes? Inventors, my clients are immediately informed of every step in the prosecution of their applications. Write now send sketch. Office of Warner I. Cubberley, Patent Attorney, 20 National Union Building, Washington, D. C.

SPECIAL service contains excellent mail-order plans and valuable information, 25 issues, $1.00. Two sample numbers, 10c. A. Hyde, 23 West 31st Street, New York.

ART leaded stained glass window work, beautiful effects produced for homes, churches, signwork, etc. Complete instructions with necessary material, illustrated particulars free. Ed. Mahler (Box 5), Woodhaven, New York.

LEARN all about auto tractor and gas engine business. Splendid opportunity to every ambitious man wishing to earn $100.00 to $400.00 month. Write for free book, "Making you Master of the Auto." Milwaukee Motor School, Dept. 895, 555-7 Downer Avenue, Milwaukee.

FREE—The Western Miner three months to get acquainted; devoted to an exceptional investment and general news. The Western Miner, 2541 West 37th Avenue, Denver, Colorado.

SIGNS—Start a business at home, something every store needs. Learn to make glass and electric signs by our new easy process without the use of brush. Big money, easy to learn. First sign will pay cost of learning. Morris Electric Sign & Mirror Co., Box 74, Westport Station, Kansas City, Missouri.

WE will start you in the cleaning and dyeing business, little capital needed, big profits. Write for booklet. The Ben-Vonde System, Dept. E, Charlotte, North Carolina.

NEW Discovery: will increase your income $50-$100 weekly, spare time; no canvassing or mail order. Send stamp immediately for valuable pamphlet. Ferber Company, 296 Broadway, New York.

PATENTS for sale. To sell, buy or obtain patents address Patent News—34, Washington, D. C.

"HOW to Win" is the story you can get by addressing postcard to Abner Davis, Ft. Worth, Texas.

INTERESTING Books, Money-making Ideas and Information. Particulars for stamp. Delbert D. Green, Leslie, Michigan.

LOCAL Representative everywhere. Paying positions. No soliciting. References required. Karam's Institute, 22 East 5th, Oklahoma City, Oklahoma.

THE Mail Order Review—Leading Mail Order Journal published. 24 pages of money-making ideas, plans, schemes, formulas. Year $1.00; sample 10c. D. Oswald Pforr, Baltimore, Maryland.

TEXAS Oil Map. Send ten cents. The Tex-Lou-Mex Syndicate, Wichita Falls, Texas.

"GOLDEN Opportunities." Livest Mail Order Magazine. Real plans, opportunities. Sample 10c. Cain (Publisher), Medina, New York.

PATENTS—Book free. Send sketch for free opinion of patentable nature. Talbert & Talbert, 4847 Talbert Building, Washington, D. C.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

STAMPS AND COINS

NEVER Sell Old Coins until you see our Copyrighted 6x9 Illustrated Coin Value Book (New Edition)—showing high prices we pay. $100.00 paid for 1894 dime. S Mint. Send 10c for your copy to-day. You may have valuable coins. International Coin Co., Box 151-M, Philadelphia, Pennsylvania.

CALIFORNIA gold, quarter size, 27c; $½ size, 53c. White cent and catalogue 10c. Norman Shultz, King City, Missouri.

100 Different Stamps, 10c; 200, 25c. Approvals. Michaels, 5600 Prairie, Chicago.

STAMPS—61 different, also interesting Lists free. Postage 2c. Payn Stamp Company, 138 North Wellington Street, Los Angeles, California.

50 Excellent stamps—8c. Roesslers' Stamp News, year 25c—Merit approvals—60% discount. 5 French Colonies Free. Postage 2c. Edwin Bailey, Farmingdale, New York.

158 Genuine Foreign Stamps—Mexico War Issues Venezuela, Salvador and India Service, Guatemala, China, etc., only 10c. Finest Approval Sheets 50% to 60%. Agents wanted. Big 72-p. Lists Free. We buy stamps. Established 25 years. Hussman Stamp Company, Dept. 55, St. Louis, Missouri.

STAMPS, 20 All Different, 3 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

$2 to $600 paid for hundreds of old coins dated before 1895. Send 10 cents at once for new illustrated coin value book. Size 4x7. It may mean your fortune. Clarke & Co., Coin Dealers, Box 76, LeRoy, N. Y.

PACKET "A" 100 varieties foreign stamps, 20c. F. J. Pope, Charlotte, Vermont.

17 varieties Bulgaria stamps, 20c. List of 7,000 varieties low priced stamps free. Chambers Stamp Co., 111C, Nassau Street, New York City.

STAMPS—50 varieties, Transvaal, Brazil, Peru, Cuba, Mexico, etc., and Album 10c. 50 different U. S., 25c. 1,000 hinges, 12c. 1,000 mixed 40c. List free. I buy stamps. C. Stegman, 5949 Cote Brilliante, St. Louis, Missouri.

CALIFORNIA gold, quarter size and Columbia Nickel, 30c. Villa coin and catalog, 10c. Homer Schultz, Union Star, Missouri.

STAMPS—50 different British Guiana, China, Jamaica, Portugal, Venezuela, etc., 10c; 1,000 all different, fine collection in itself, $5.00; 100 var. U. S., 30c; 1,000 hinges, 10c; Agents wanted, 50%. List free. I buy stamps. L. B. Dover, Overland, Missouri.

BEST one cent approvals in America. F. P. Hand, 1117 South 60th Street, Philadelphia, Pennsylvania.

STAMPS free! 60 all different for the names of two collectors and 2c postage! 30 Sweden stamps 10c; 20 Denmark stamps 10c. Toledo Stamp Company, Toledo, Ohio, U. S. A.

OLD coins, large spring selling catalogue of coins for sale, free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101-A Tremont Street, Boston, Massachusetts.

60 Different Asia stamps 25c; C. Reitter, Box 1054, Detroit, Michigan.

TRIANGLE Approvals—½c up. Three unused stamps Free to approval applicants sending references. Harfred Stamp Company, Dept. S, Germantown, Pennsylvania.

THOUSANDS paid for Old Coins. Save all before 1898 and send for 1920 premium book, ten cents, with large copper cent fifteen cents, it may mean your fortune. E. C. Harr, Nora Springs, Iowa.

FRENCH Colonial stamps—9 beautiful unused pictorial varieties, 5c. Fennell Stamp Company, Dept. C, Fullerton Building, St. Louis.

FREE! Jamaica commemorative stamp to approval applicants. Reference. Riedell, Schenectady, New York.

BEAUTIFUL French Colonial stamps, 150 different, $1.00. Nickles, 122 Florida Avenue, Washington, D. C.

50,000 coins, medals, bills, stamp collections, antique firearms, relics. Lists free. Nagy, 33 South 18th, Philadelphia.

REFERENCES bring free packet and low priced approvals. J. W. Hyson, Melrose, Massachusetts.

800 stamps, only 25c. John Hammond, 700 Gladstone, Baltimore, Maryland.

PACKET 250 fine mixed foreign from old collections 50c. Six packets $2.00. Bert Fagan, Room 432, 1400 Broadway, New York.

OLD coins wanted. 24 page buying catalogue, 10c. A. Kraus, Kraus Building, Milwaukee, Wisconsin.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

These Are the Hours that Count

MOST of your time is mortgaged to work, meals and sleep. But the hours after supper are *yours*, and your whole future depends on how you spend them. You can fritter them away on profitless pleasure, or you can make those hours bring you position, power, *real success* in life.

Thousands of splendid, good-paying positions are waiting in every field of work for men *trained to fill them.* There's a big job waiting for *you*—in your present work, or any line you choose. Get ready for it! You can do it without losing a minute from work, or a wink of sleep, without hurrying a single meal, and with plenty of time left for recreation. You can do it in one hour after supper each night, right at home, through the International Correspondence School.

Yes—you can win success in an hour a day. Hundreds of thousands have proved it. The designer of the Packard "Twin-Six" and hundreds of other Engineers climbed to success through I. C. S. help. The builder of the great Equitable Building, and hundreds of Architects and Contractors won their way to the top through I. C. S. spare-time study. Many of this country's foremost Advertising and Sales Managers prepared for their present positions in spare hours under I. C. S. instruction.

For 28 years men in offices, stores, shops, factories, mines, railroads—in every line of technical and commercial work—have been winning promotion and increased salaries through the I. C. S. Over 110,000 men are getting ready *right now* in the I. C. S. way for the bigger jobs ahead.

No matter where you live, the I. C. S. will come to *you*. No matter what your handicaps, or how small your means, we have a plan to

meet your circumstances. No matter how *limited* your previous education, the simply written, wonderfully illustrated I. C. S. textbooks make it easy to learn. No matter what career you may choose, some one of the 280 I. C. S. Courses will surely suit your needs.

When everything has been made easy for you—when one hour a day spent with the I. C. S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means—can you afford to let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you. Just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7682, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ADVERTISING	☐ ELECTRICAL ENGINEER	☐ MECHANICAL ENGINEER
☐ SALESMANSHIP	☐ Electrician	☐ Mechanical Draftsman
☐ Traffic Management	☐ Electric Wiring	☐ Machine Designer
☐ BUSINESS MANAGEMENT	☐ Electric Lighting	☐ Machine Shop Practice
☐ Private Secretary	☐ Electric Car Running	☐ Boilermaker or Designer
☐ Commercial Law	☐ Heavy Electric Traction	☐ Patternmaker
☐ Certified Public Accountant	☐ Electrical Draftsman	☐ Toolmaker
☐ Higher Accounting	☐ Electric Machine Designer	☐ Foundry Work
☐ Railway Accountant	☐ Telegraph Engineer	☐ Blacksmith
☐ BOOKKEEPER	☐ Telephone Work	☐ Sheet Metal Worker
☐ Stenographer and Typist	☐ ARCHITECT	☐ STEAM ENGINEER
☐ Good English	☐ Architectural Draftsman	☐ Stationary Fireman
☐ Window Trimmer	☐ Contractor and Builder	☐ GAS ENGINE OPERATING
☐ Show-Card Writer	☐ Building Foreman	☐ Refrigeration Engineer
☐ Sign Painter	☐ Carpenter	☐ CIVIL ENGINEER
☐ CIVIL SERVICE	☐ Concrete Builder	☐ Surveying and Mapping
☐ Railway Mail Clerk	☐ MARINE ENGINEER	☐ R. R. Constructing
☐ Mail Carrier	☐ PLUMBER & STEAM FITTER	☐ Bridge Engineer
☐ CARTOONIST	☐ Heating & Ventilation	☐ SHIP DRAFTSMAN
☐ Illustrator	☐ Plumbing Inspector	☐ Structural Draftsman
☐ Perspective Drawing	☐ Foreman Plumber	☐ Structural Engineer
☐ Carpet Designer	☐ MINE FOREMAN OR ENGINEER	☐ Municipal Engineer
☐ Wallpaper Designer	☐ Coal Mining	☐ CHEMIST
☐ Bookcover Designer	☐ Metal Mining	☐ Analytical Chemist
☐ TEACHER	☐ Metallurgist or Prospector	☐ NAVIGATION
☐ Common School Subjects	☐ Assayer	☐ Motor Boat Runn'g ☐ Spanish
☐ High School Subjects	☐ TEXTILE OVERSEER OR SUPT.	☐ AGRICULTURE ☐ French
☐ Mathematics	☐ Cotton Manufacturing	☐ Fruit Growing ☐ Italian
☐ AUTOMOBILE OPERATING	☐ Woolen Manufacturing	☐ Vegetable Growing
☐ Automobile Repairing	☐ Locomotive Engineer	☐ Live Stock & Dairying
☐ Auto. Electrical Work	☐ Roundhouse Foreman	☐ POULTRY RAISER

Name_____

Occupation and Employer_____

Street and No._____

City_____ State_____

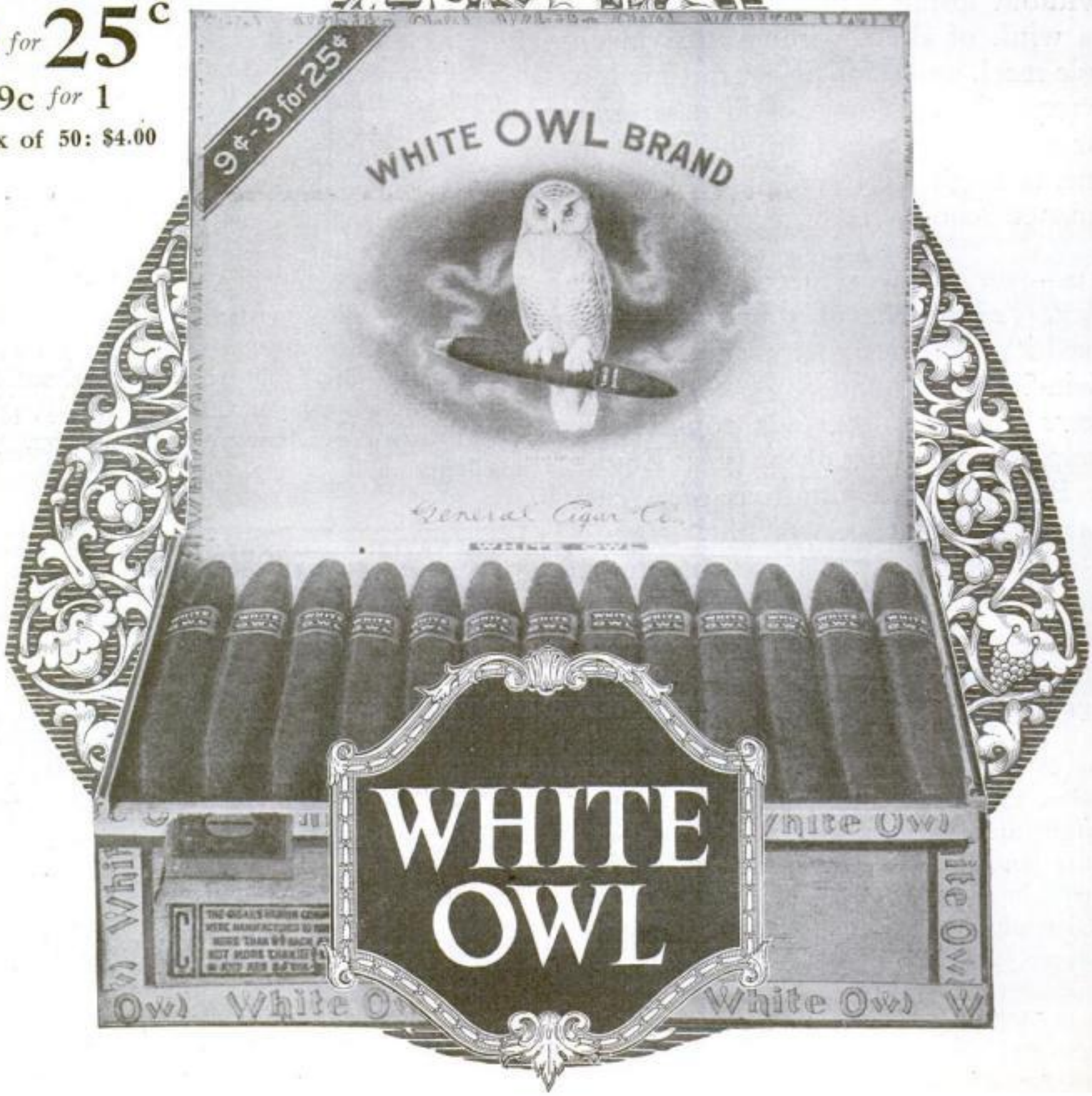
7-25-19

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

IN RECENT YEARS no cigar has attained so rapidly the standing enjoyed today by WHITE OWL. Three facts explain why— (1) the fine character of its leaf, mellowed slowly by time and ripe experience, (2) the handsome, tapering, full-size Invincible shape, fashioned with real craftsmanship and (3) the superior buying resources of its sponsors, the General Cigar Co., Inc. Under existing conditions the production of WHITE OWL at its present price is a genuine achievement in cigar making.

General Cigar Co., Inc.
DEPENDABLE CIGARS
119 West 40th Street, New York City

3 *for* 25c
9c *for* 1
Box of 50: $4.00



Popular Science Monthly

Waldemar Kaempffert, *Editor*

July, 1920; Volume 97, No. 1
25 Cents a Copy; $3 a Year

Published in New York City at
225 West Thirty-ninth Street

Racing for the "America's" Cup

When sport becomes a science

By Joseph Brinker

SIR THOMAS LIPTON has come to this country with one of the most remarkable and sensationally radical challengers that ever crossed the Atlantic. Yachting experts who have seen the hull of the *Shamrock IV* agree that she is perhaps the lightest and yet the most powerful British racing creation that has ever visited our shores.

The features of design that stand out conspicuously are the extremely long keel; the full form of the hull in the bow and stern sections; the bulge of the sides of the hull inward at the top or deck; and the unusually lofty sail rig. The hull is of the lightest composite construction, the planking being laid in three plies with the two inner layers placed diagonally. The outer layer of the planking runs longitudinally.

Because of the long keel, with the lead placed low, yachting experts predict that the best chance of success of the *Shamrock IV* lies in a strong offshore breeze. Then her great sail spread will drive her through the water at a high speed. In light breezes the chances of winning are not considered so good, because her large keel will present a big area of wetted surface, and the "skin" friction between it and the water will tend to decrease her speed.

Against the *Shamrock IV* either the *Resolute* or the *Vanitie* will race. These yachts resemble each other to a far greater extent than either one resembles the *Shamrock IV*. Both of the American boats are approximately 75 feet on the water-line, the *Vanitie* being the larger when measured by the extent of the part that overhangs the water-line dimensions. The *Vanitie* has the larger sail area, carrying 9,465 square feet of canvas, compared with 8,188 square feet of sail carried by the *Resolute*, which is slightly narrower, but has a body that is more full beneath the water-line where the hull joins the vertical sides of the keel. All three of the contestants are provided with centerboards set in the bottom of the keels.

© Edwin Levick

The racers coming head-on. From left to right are the *Resolute*, the *Vanitie*, and the *Defiance*. The *Vanitie* has a greater sail area than the *Resolute*

No matter which boat is selected to defend the Cup, she will compare in general design more closely to her foreign rival than did America's earliest cup contestant, the *America*. In the span of seventy-nine years from the *America* to the *Resolute* and the *Shamrock IV*, there has been a remarkable evolution in the design of the racing yacht.

The *America* was built to beat the sloop *Maria*, then the fastest pilot-boat in New York harbor. While she did not beat the *Maria*, she proved to be so fast for a schooner that the yachtsmen who had ordered the boat accepted her and made ready for the trip across the Atlantic. The route was to Havre. It was made in seventeen and one half days.

After watching the *America*, with her widest beam amidships and fine lines fore and aft, the British accepted the American type of clipper

bow. But, because of the deep British waters, the hulls were deep and narrow. In America the conditions favored boats of greater beam and less draft because of the shallow waters. The British type is exemplified in the *Genesta* of 1885, as shown in one of the accompanying illustrations, and the American type in the *Mischief*, which was built in 1881.

Coming development was seen in the *Thistle*, the challenger for the Cup in 1887. She was wider in proportion to her depth than any previous contestant. Then came the *Valkyrie I* in 1893, with a fixed, finlike keel instead of a centerboard, because a fixed keel can carry from sixty to ninety tons of lead. Finally the British type of narrow, deep hull gave way to the wide but shoal hull with a deep fin keel to carry lead ballast. The *Reliance*, an example of this type, with a water-line length of about 90 feet and an over-all length of 140 feet, carrying 16,000 square feet of sail—the largest ever carried by a Cup yacht—was perhaps the acme of the highly developed racing machine.

But the *Reliance* and the *Shamrock III* were rule-beating freaks, which, as soon as the Cup races were over, were broken up on the junk-pile because of their extreme design, their unseaworthiness, and the inability to get other boats to race against them in club regattas. Because these boats had developed into freaks, the racing rules were changed. The *Resolute*, the *Vanitie*, and the *Shamrock IV*, all with a water-line length of 75 feet instead of the 90 feet of the *Reliance* are far more wholesome boats, and will probably see many years of regatta racing before they are discarded.

The old racing rule put a tax on water-line length and sail area, but on nothing else. Provided the yacht did not exceed 90 feet in length on the load water-line, she could be as broad and deep, and as long over all, as desired. The boats built under the old rule drew too much water for cruisers sailing in the shallow American harbors. To save weight the hulls themselves were made so shallow that there was insufficient headroom below the deck for comfortable accommodations. These reasons lie behind the fact that all of the racing machines of recent years were broken up for junk after the completion of the races.

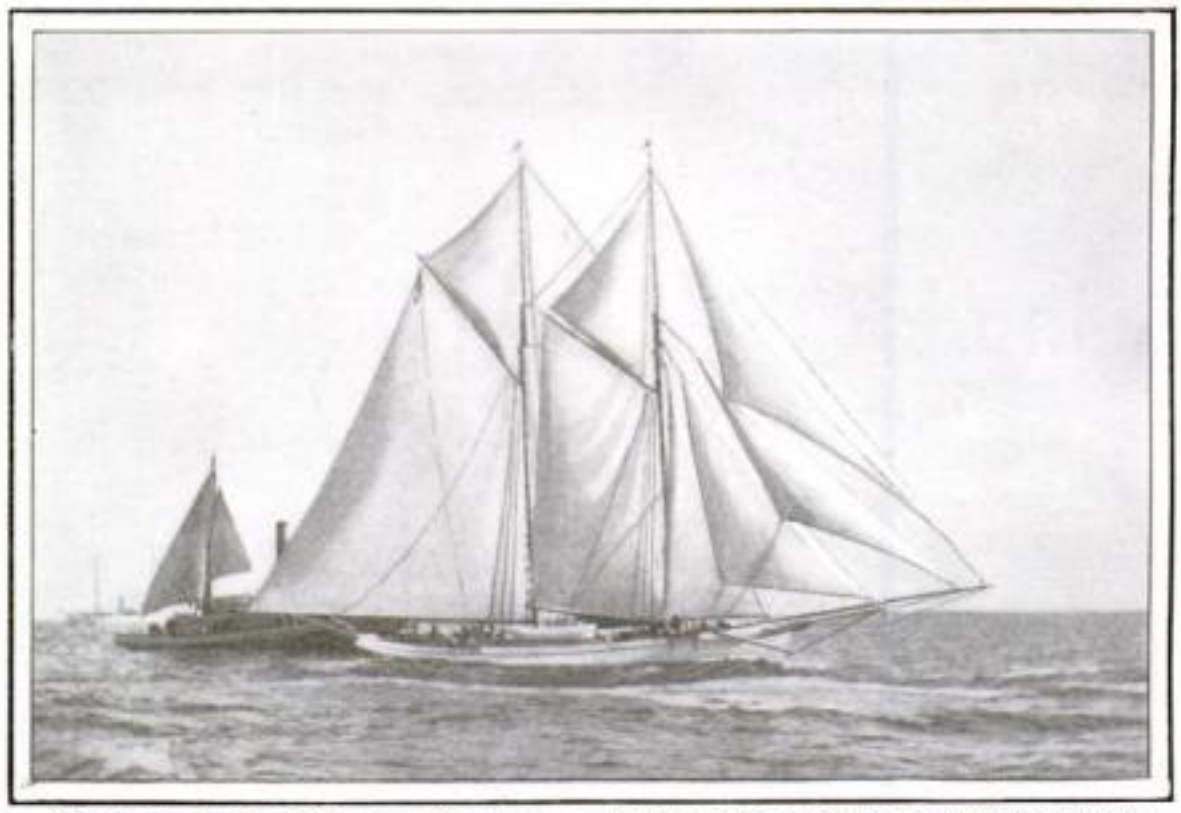
The new rule and the formula by which the rating of the yacht is determined includes the factors of sail area, length, and displacement. The rating is determined by the formula:

$$\text{Rating} = 0.18\,\frac{\text{L}\sqrt{\text{Sail Area}}}{\sqrt[3]{\text{Displacement}}}$$

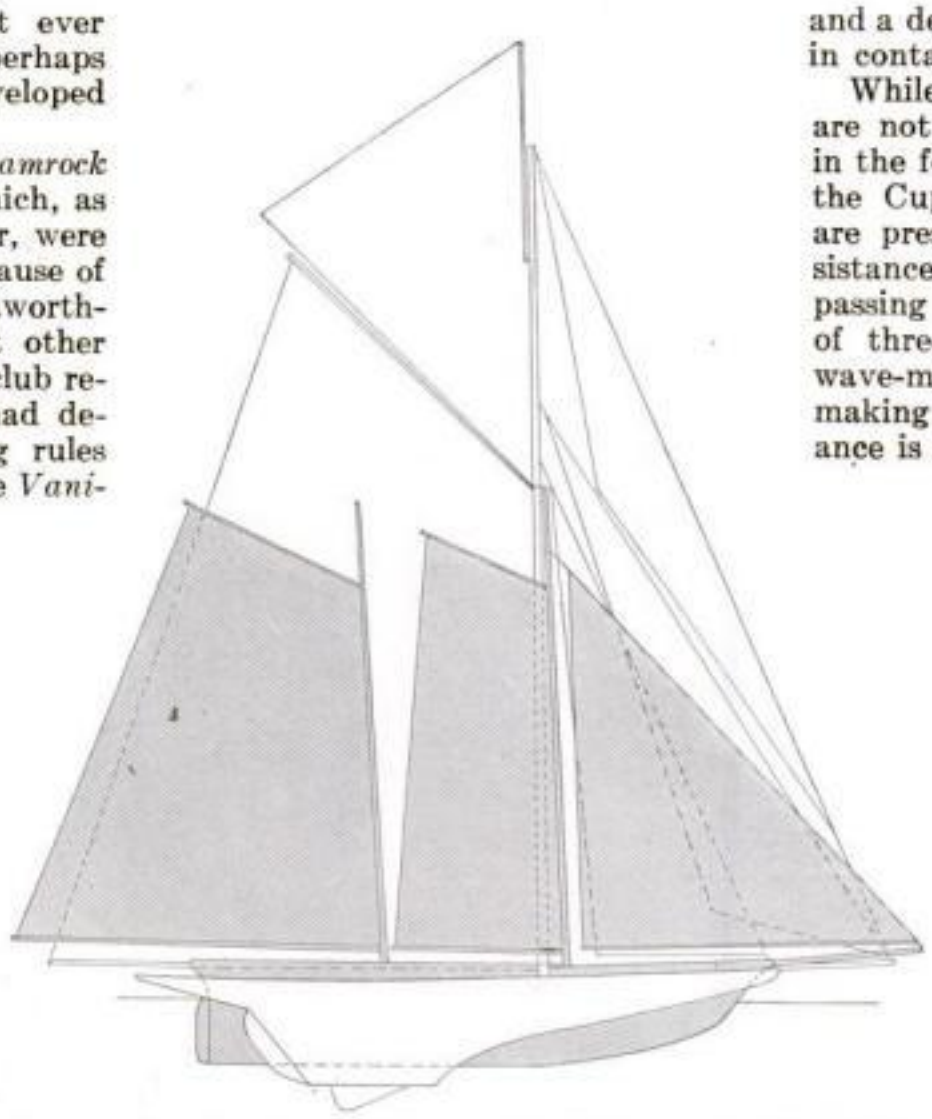
Because the displacement factor is the denominator of the fraction, and because the larger the denominator the smaller becomes the final fraction or rating, it is seen that the new rule favors boats of larger displacement. Other things being equal, the boat with the larger displacement will have the smaller rating and will receive a larger time allowance.

The *Vanitie* departs less from the old rule than the *Resolute*. The *Resolute* has a fuller and deeper under-water body and is built more closely to the rule, as shown by her sharp ends, deep V sections, and large displacement. The *Shamrock IV* is a compromise between the extremes of the *Shamrock III* and the *Reliance*. The *Shamrock IV* is full ended, with a large sail area and a deep keel having a large surface in contact with the water.

While the elements of yacht design are not expressed in so many words in the formula by which the rating of the Cup yachts is determined, they are present just the same. The resistance that a vessel encounters in passing through water is made up of three kinds—frictional resistance, wave-making resistance, and eddy-making resistance. Frictional resistance is that due to the friction of the water on the under-water surface of the vessel. It depends upon the area of the surface and the nature and shape of the surface. This resistance is known as skin friction, and forms a large part of the total resistance at low speeds. It is, of course, decreased by cutting down the area of the hull in contact with the water. This area is commonly called the "wetted surface." The speed of the boat depends upon the ratio of the sail area to the wetted surface. Without unduly reducing the area of wetted surface, it is the task of the yacht designer properly to proportion the ratio of the sail area to the wetted surface. Because the



The first winner of the cup, the *America*. Though a swift schooner in her day, the boat does not compare in speed with the modern racing yacht built with a full hull and extremely long keel. The *Resolute* and the *Vanitie* could sail around her in circles, because of their modern construction

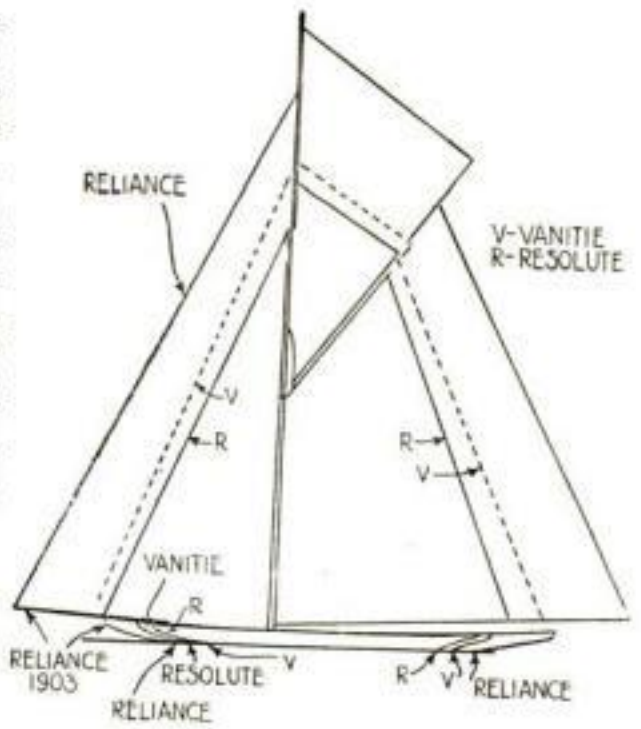


Compare the *America*, which won the race in 1851, with the *Resolute*. While the *America* was about 13 feet longer than the *Resolute* on the water-line, she was less in length over all, on account of the extent of that part of her construction that "overhangs" the water-line measurement. The *America* is indicated by the darkened portion, to show the difference in the shape of the hull and the relative sail area

skin friction is the most important resistance to the progress of the yacht through the water, that vessel with the larger ratio of sail area to wetted surface will be faster, other things being equal.

In designing the *Shamrock IV*, Nicholson gave her an extremely long keel. This greatly increased the area of the wetted surface, but also enabled him to spread the lead in the keel out longitudinally instead of building it up vertically. Hence the center of gravity of the lead lies lower, and this in turn means greater sail-carrying capacity for the same weight. Because of this low-placed lead and great sail area, which increases her speed in strong breezes, yachtsmen contend that the *Shamrock IV* will have her best chances of winning in strong winds.

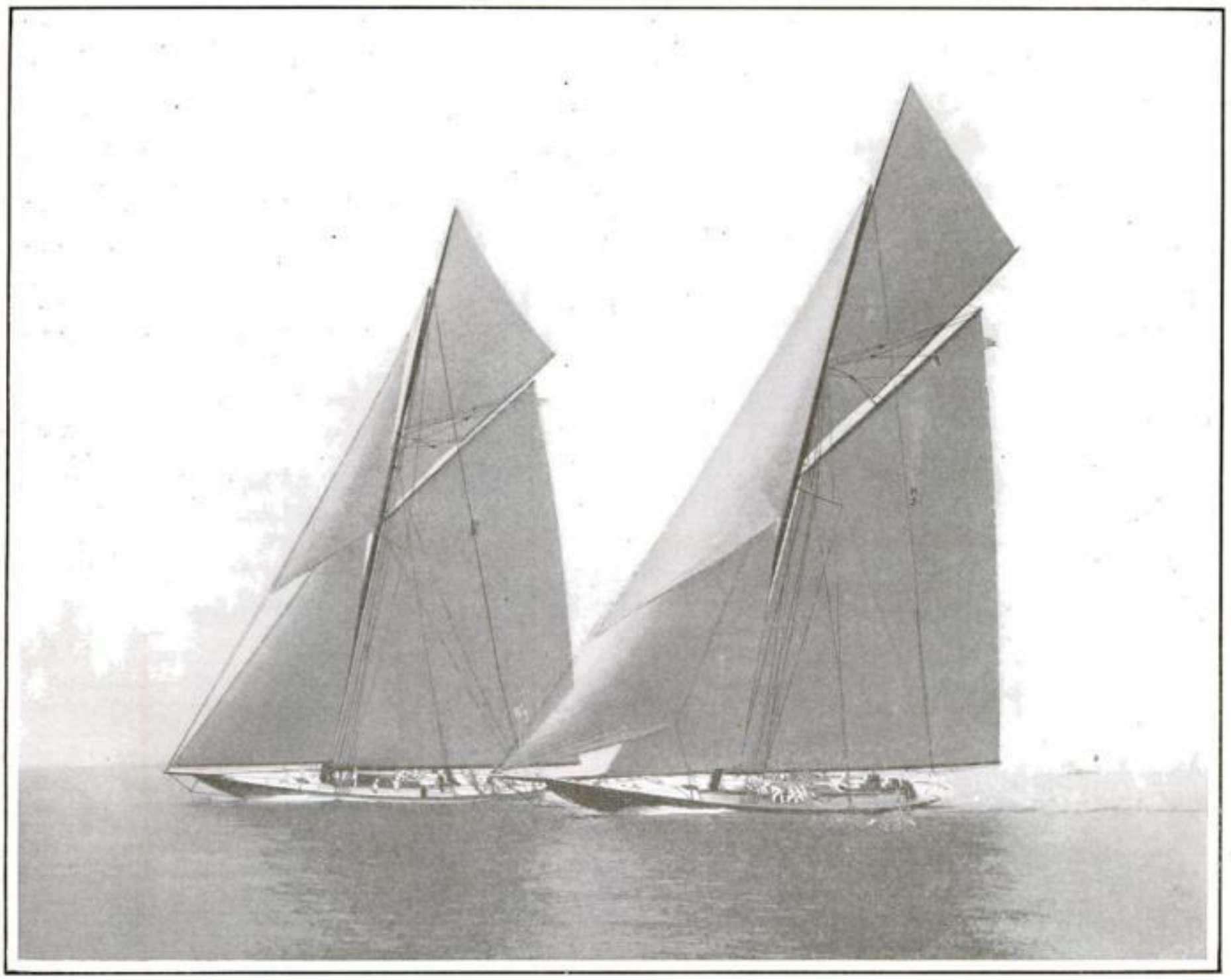
At lower speeds in light airs, where the wetted surface and its skin friction are the most important considerations, the Lipton yacht will be at a great disadvantage compared with either the *Resolute* or the *Vanitie*, which have a much smaller area of wetted surface. The bottom length of the keel of the *Resolute* is only about half



A comparison of the rig and sail plan of the *Resolute* and the *Vanitie*, with that of the *Reliance*, which defeated the *Shamrock III* in 1903. The *Reliance* was 90 feet long on the waterline and 140 feet overall. The waterline length of both the *Resolute* and the *Vanitie* is 75 feet. The *Reliance* carried 16,000 square feet of canvas. The *Resolute* carries 8,188 square feet of sail, the *Vanitie*, 9,465 square feet

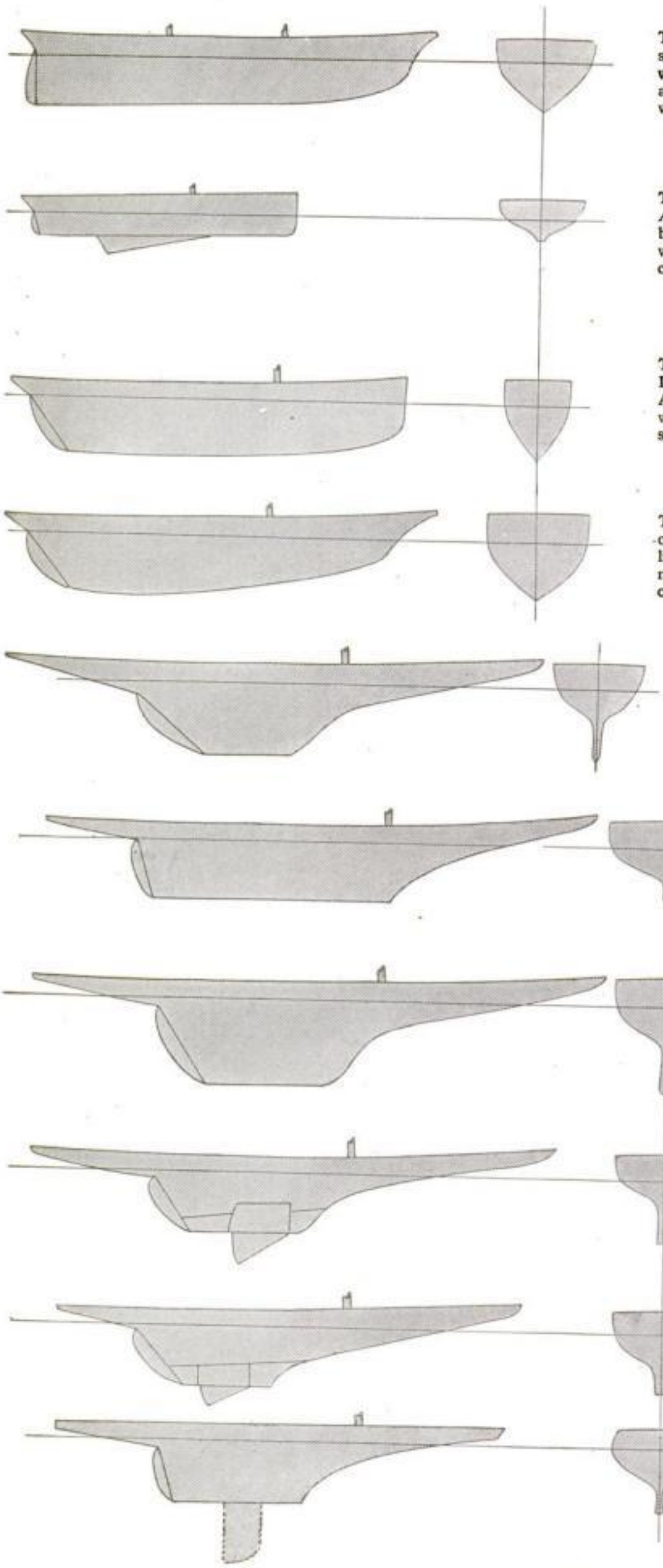
that of the *Shamrock IV*. Although changes may be made in the rig of the *Shamrock IV* before she crosses the starting line on July 15, she may carry approximately 10,000 square feet of sail area as compared with the 8,188 square feet of the *Resolute*. If these ratios hold true, the *Shamrock IV* will probably have to give the *Resolute* three or four minutes of time allowance. This is an important factor, for on at least one occasion the American defender of the Cup beat the British challenger on time allowance. That was the race between *Columbia* and *Shamrock II* on October 4, 1901, when the *Shamrock II* actually beat the *Columbia* by two seconds on elapsed time, but lost the race by forty-one seconds because she had to give the *Columbia* a time allowance of forty-three seconds.

Some idea of the tremendous sail spread of the *Resolute* may be gained from the fact that if her sails were made from ordinary bed-sheets, fifty-four inches wide by eighty-one inches long, it would require 270 of these sheets, sewed end on end, to give the equivalent sail area.



The *Resolute* at the left and the *Vanitie*, at the right, cutting gracefully through the water. The "lines" of the sails are calculated to lie perfectly straight in the wind in the speed of the race

Famous Contestants for the "America's" Cup



The America

The most notable peculiarities of the *America* were in the sharpness of her bow and in the shape of her hull on the sides which rose from the keel in straight lines, each pair forming a sharp V. She was only 94 feet over all; 88 feet on the water-line; 22 feet beam, and had 11½ feet maximum draft

The Mischief

The *Mischief* was an iron sloop, much smaller than the *America;* she had a draft of only 5 feet, but a deep centerboard. She had a beam of 20 feet, with a length on the water-line of 61 feet. The *Mischief* defeated the Canadian challenger, *Atalanta*, in two out of the three races sailed

The British Cutter Genesta

The British cutter *Genesta* was built along entirely new lines. In light winds she was an easy mark for the *Puritan*, the American defender, but in a heavy blow showed such seaworthy qualities that her last race with the *Puritan* was considered one of the best Cup races of any sailed up to 1885

The Scotch Cutter Thistle

The Scotch cutter *Thistle* marked a new departure in British challengers. She was 108 feet over all; 86 feet on the water-line; 20 feet beam and 13¾ feet draft. Her underwater hull near the bow was well cut away and she carried 55 tons of lead on her keel. Inside she carried ten tons of lead

The Valkyrie

The *Valkyrie I* was the prototype of the present day racing yacht with long overhangs at the bow and stern. She was the biggest of the challenging sloops up to 1893 and was 126 feet over all, 85 feet on the water-line, and she had a draft of 16½ feet. She carried 10,042 square feet of sail

The Vigilant

The *Vigilant* which defeated the *Valkyrie I* in two races in 1893, was deeper and wider than any cup defender built up to that time. She was designed and built by Nat Herreshoff. Her sail area was 11,272 square feet

The Columbia

The *Columbia*, which defeated Sir Thomas Lipton's *Shamrock I* in 1899, was the most pronounced skimming-dish type of hull up to that year. The hull proper with a beam of just 24 feet had a depth of only 7 or 8 feet

The Vanitie

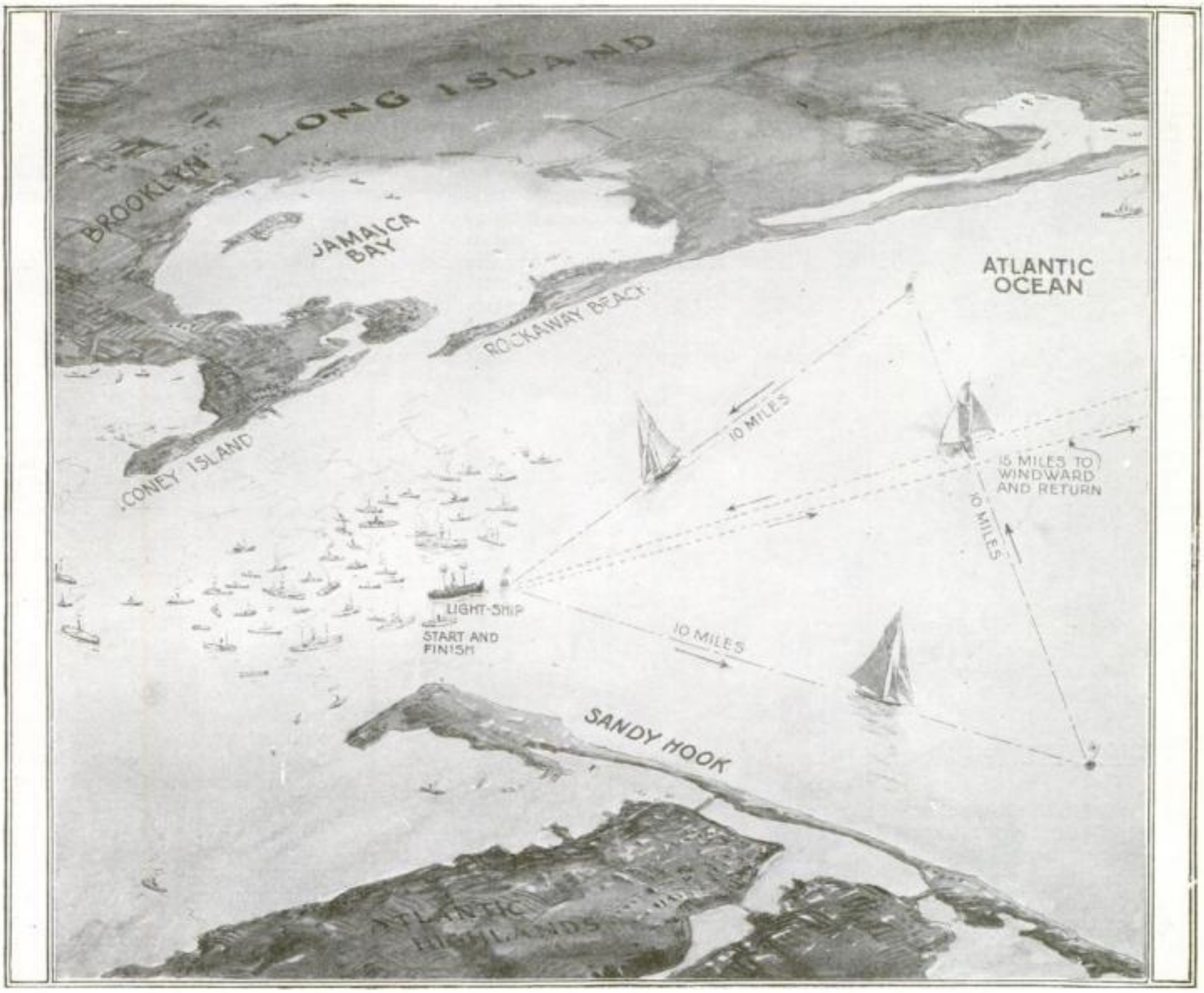
One of the contestants for the honor of defending the *America's* cup this year, the *Vanitie*, has 65 tons of lead in her keel and draws 13¾ feet of water exclusive of a small centerboard. She is 119 feet in length over all, but only 75 feet on the load water-line

The Resolute

The *Resolute*, the second candidate for the defense of the Cup this year, is similar to the *Vanitie* in design except that she has fuller underwater body lines and shorter overhangs

The Shamrock IV

In his fourth attempt to win the Cup, Sir Thomas Lipton has brought over in *Shamrock IV* one of the most remarkable challengers built. Her keel is extraordinarily long, measuring about 35 feet along the bottom



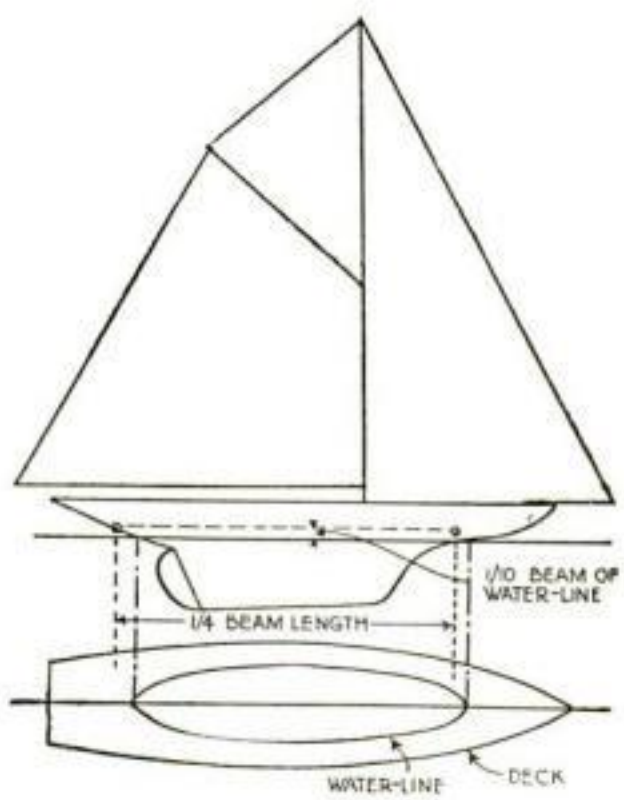
The race-course for the yachts off Sandy Hook. The first race for the *America's* Cup will be held on July 15. It will be a race fifteen miles to windward and return, as indicated by the dotted lines in the center of the triangle. Three out of five races must be won. The second and alternate races will follow the triangle, each side of which is ten miles long, making the total length thirty miles. These races will be sailed on Tuesdays, Thursdays, and Saturdays until the winner is decided

While the present racing rule gives a bigger rating the longer the water-line length and the larger the sail area, the length L in the formula is not the water-line length, nor does the rating increase in the direct ratio of the sail area. The sail area rating increases as the square root of the area, and it follows as a matter of course that four times the sail area would double the rating. The cube root of the displacement, being the denominator of the rating fraction, helps to give a smaller rating as the displacement increases, and this means greater seaworthiness of the boat. The length L in the formula is not the water-line length, but a corrected length which includes the load water-line length plus one-half the excess of the quarterbeam length over the percentage of the load water-line length given by the formula:

$$P = 100 - \sqrt{\text{load water-line length}}$$

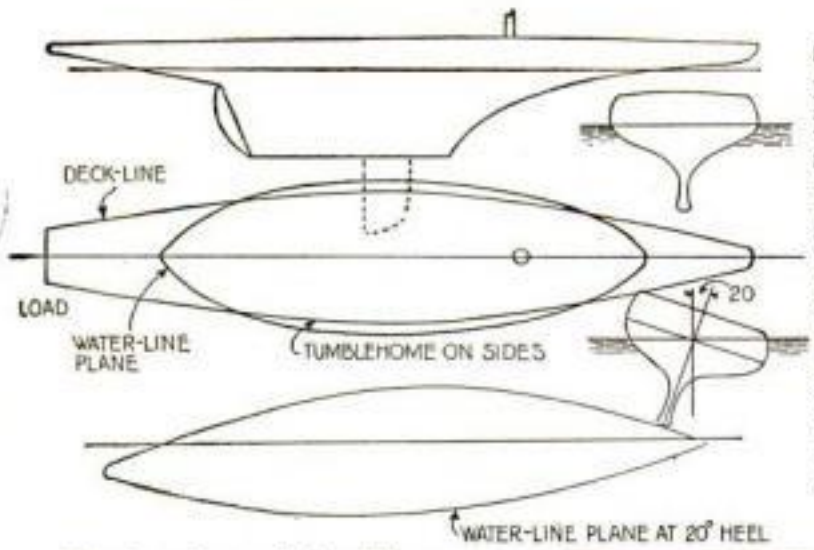
The formula quarter-beam length is determined as shown in the accompanying sketch, and is employed to prevent beating the rule by freak designs in the bow and stern overhangs.

The rating, as determined by the above formula, gives the time allowance, which depends upon the assumption that a yacht of racing measurement R will sail a nautical mile in the number of seconds shown by the formula:



Sail area, displacement, and water-line length

Sail area, displacement, and water-line length are considered in determining the rating of a racing yacht, with the time allowance that must be given a vessel of smaller rating. The water-line length is not measured on the load water-line, but is a corrected length which includes the load water-line length plus one-half of the excess of the quarter-beam length, divided by a certain percentage of the water-line length determined by another formula. The quarter-beam length is measured as indicated in the sketch at the left



The drawings of the *Shamrock IV* show the tumble-home of sides of the hull in the center. The form of the hull at bow and stern is shown by the increase in area of the water-line plane when the *Shamrock IV* is heeled over to an angle of twenty degrees in the water

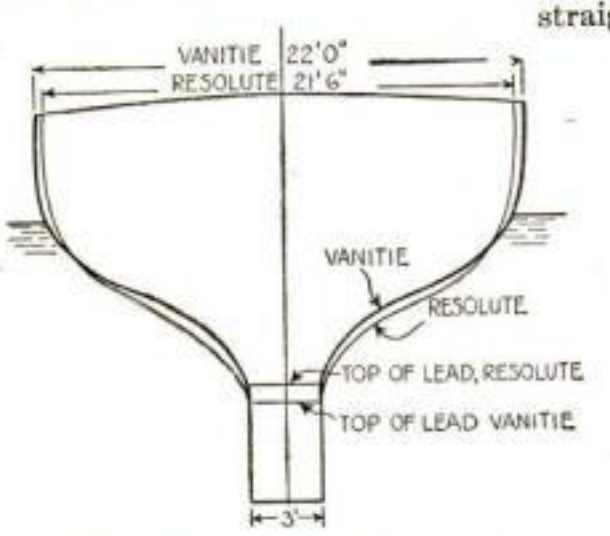
$$\frac{2160}{R}+183.62$$

For a yacht of a different rating r, the allowance per mile between the two yachts will therefore be expressed by the formula:

$$\frac{2160}{r}-\frac{2160}{R}$$

in which R is the rating measurement of the larger yacht and r that of the smaller one. Tables have been worked out to give the time allowance in seconds for any given difference in rating.

In these days of airplanes, motor-boats, and swift automobiles, the racing of yachts seems a tame sort of sport. But the modern yacht race is indeed the keenest of sports. To those who like the touch of the salt air, and who delight in the sight of a trim sailing-craft leaning in the wind, the race for the Cup has lost none of its former charm.



The chart shows the narrower width of the *Resolute* compared with the *Vanitie*, and the fullness of lines of the *Resolute* under water. The lead keel is higher than that of the *Vanitie*. The keel of each boat is three feet wide at the base

What more could be desired, on the day when the race begins, than a "spanking" breeze, a sun-glistening sea with waves of just the right size to add spirit to the scene? If the present race is like its predecessors, a procession of tugs, launches, motor-boats, excursion steamers, and all manner of craft will pass through the Narrows to take the throng of yachting enthusiasts

Experts agree that the *Shamrock IV* is the lightest and most powerful British racing boat ever built. The chances of winning the race will depend upon a strong offshore wind

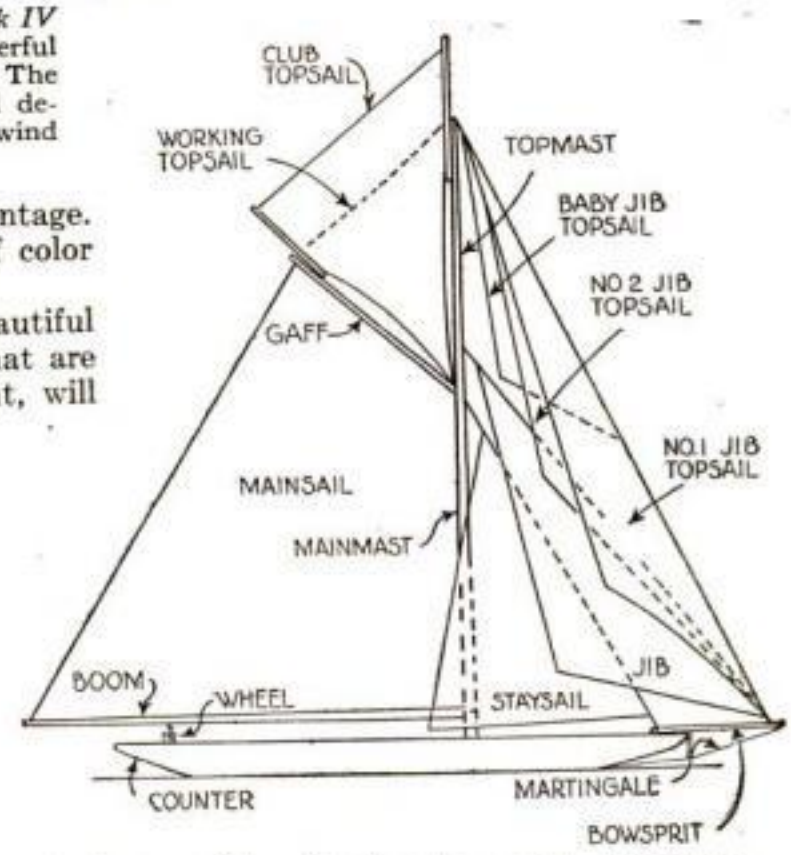
and "good sports" out to a point of vantage. It will be a gala occasion, a scene of color and life.

In the staked-off course the beautiful yachts, their sails presenting lines that are straight and beautiful in the sunlight, will be seen. Tilted in the wind, cutting through the green water, glistening where the waves have split around their bows, the yachts will speed from buoy to buoy. Thousands of eyes will be focused upon them through glasses from deck and shore, wherever a glimpse of the course can be obtained.

Whether the *Resolute*, the *Vanitie*, or the *Shamrock IV* will be first to reach the final stake, this yacht race perhaps more than others will arouse international interest in yachting. But the rules of the race will make the crowd hold its decision in reserve. It may be that no one will know, for a while, who the winner may be. If one boat skims the line a fraction of a minute before the other, this does not mean that it has actually won the race. When the rules of the "game" are applied and the proper "weights" allowed, the judges will announce the winner. Not until then will the curiosity of the crowd be satisfied.

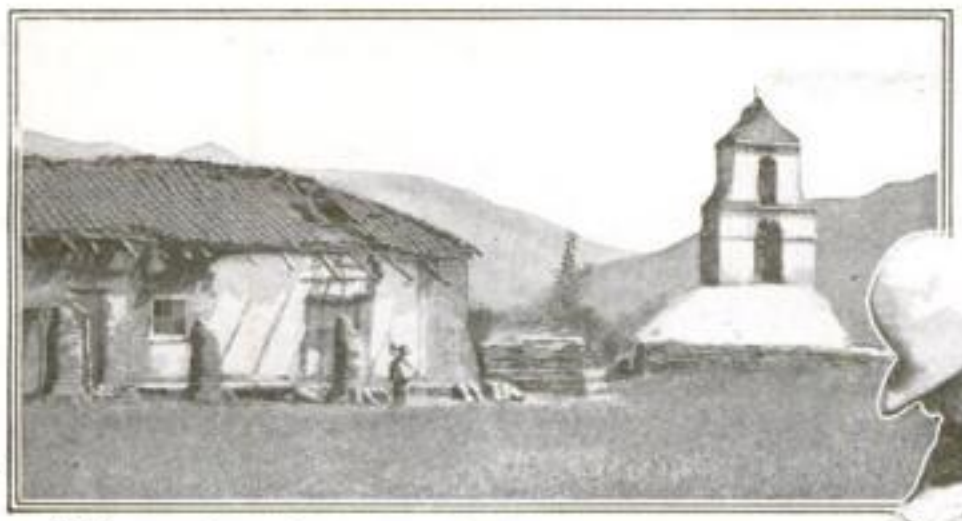
But cheering will not be hindered on account of that. It is often well for those on each side to enjoy the pleasures of success, and then to suffer the pangs of disappointment; for then everyone is given a chance to prove himself a good sport. But the man who laughs last is the one who wins the bet, and he will have to await the decision of the judges who have considered every factor and applied the mathematics of the rules.

Further zest is added to this year's races because they mark the thirteenth attempt to lift the cup, twelve made by British challengers and one by the Canadians. If Sir Thomas believes 13 is his lucky number, who can say but that when the mist lifts off the Sandy Hook course some fine morning in July, the cup will be on its way back to England? It has remained continuously in this country for 69 years or since that memorable day in 1851 when the fleet *America* outsailed the fastest that Britain could produce.



A diagram of the sails of a racing yacht. The shape of these sheets of canvas are cleverly designed to respond to the wind and air resistance. It is the manipulation of the sails combined, with their area, that speeds the craft through the water. The mainsail of the *Vanitie* weighs about one ton and the top of the mainmast towers more than one hundred feet in the air. The amount of canvas carried is almost twice that carried by the *America*

Build Your House Out of Your Own Back Yard



Adobe mud and straw, mixed together, kneaded, placed in frames, smoothed, and dried, will turn into bricks with which houses are now being built in Southern California, reviving the method of old Spanish days

Placing squares of clay in frames, to be baked into adobe bricks

HOME seekers in Los Angeles are literally grasping at straws—and mud. Their slogan is "build your house out of its own back yard." Due to lack of building materials, adobe clay mixed with straw, in Mexican fashion, is now being used in the construction of southern California bungalows.

Mexicans knead the mud and straw with their bare feet. After it is properly mixed they put it in frames, smooth it with their hands, and leave it on the ground to dry. One day in the hot sun will turn the muddy dough into bricks.

These resulting bricks are so durable that they will withstand a pressure of four hundred pounds to the square inch. Adobe is one of the most non-conductive materials known and thus houses made from it will not respond readily to heat in summer or to cold in winter. The bricks are put through a waterproofing process that removes the dampness sometimes found in adobe buildings. Owing to the large size of the bricks the houses can be erected in a very short time, and adobe houses last a long time.

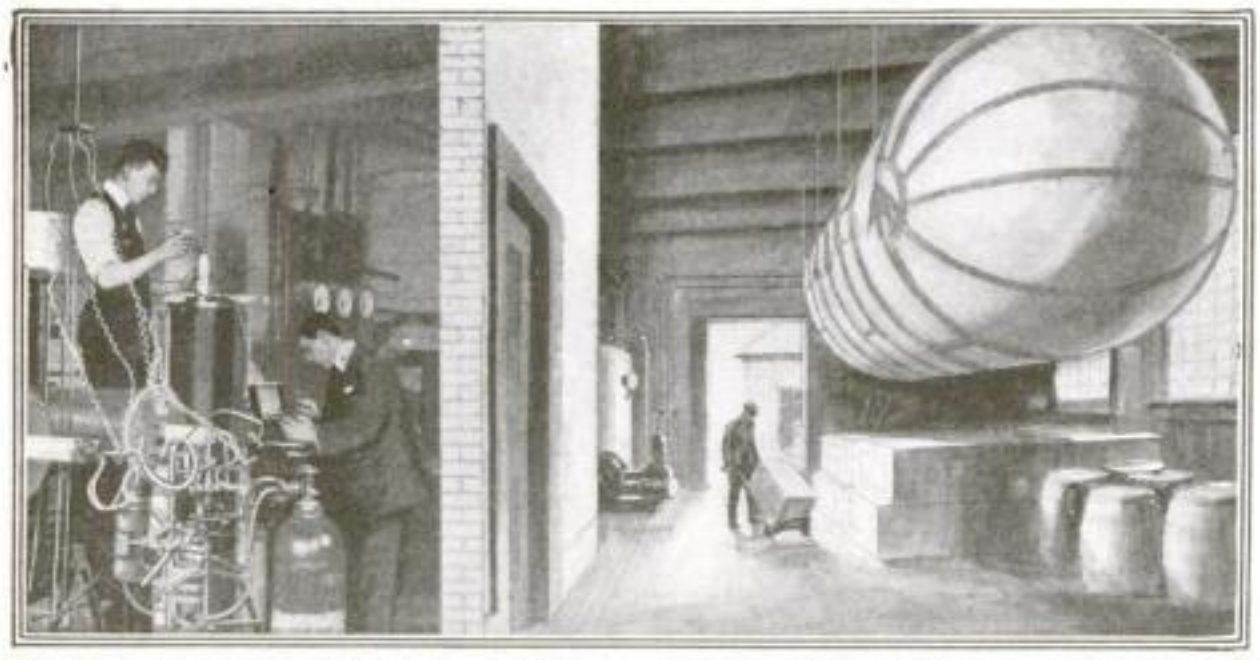
The Pala Mission was built of adobe one hundred and thirty-five years ago and it is still standing. Modern adobe structures may be finished off in concrete to look just like other bungalows. But if owners prefer the picturesque baked clay finish, concrete is omitted.

A number of country homes of this type have recently been erected in southern California where, in the old days of the Spanish régime, homes were built exclusively of the adobe clay.

Since this material is plentiful in California, thousands of p ople may soon be moving out there to build homes without encountering the high cost of lumber.

Modern adobe houses are sometimes finished with concrete, which is an improvement on the old way. The new bricks undergo a process that prevents dampness in them

Balloons Are Substitutes for Storage-Tanks



The illustration on the right shows one of the "nurse" balloons used to store gas in chemical laboratories. It saves the expense of metal tanks and can be conveniently managed by feeding the gas through a tube. On the left is pictured the method of feeding gas from a "nurse" baloon through a system of pipes and tubes in the laboratory

"HOW would you carry a large volume of hydrogen gas to the distant field where it is needed to inflate a dirigible or a kite balloon?" This might seem a problem difficult to solve unless the gas, greatly compressed, could be conveyed in metal tanks. But the solution proved a simple matter during the war. The inflating gas was taken wherever needed in small storage containers called "nurse" balloons, and from them fed into the dirigibles and kite balloons. These gas-bags are made of material which will hold their original "gas-tightness" for a long time and are cylindrical or spherical in form. The spherical types, nine feet ten inches in diameter, will hold 500 cubic feet of gas. A cylindrical balloon 33 feet long and 10 feet 6 inches in diameter will contain 2500 cubic feet of gas. The peace time use of the "nurse" balloons is an interesting instance of the conversion of a war product into a commercial utility.

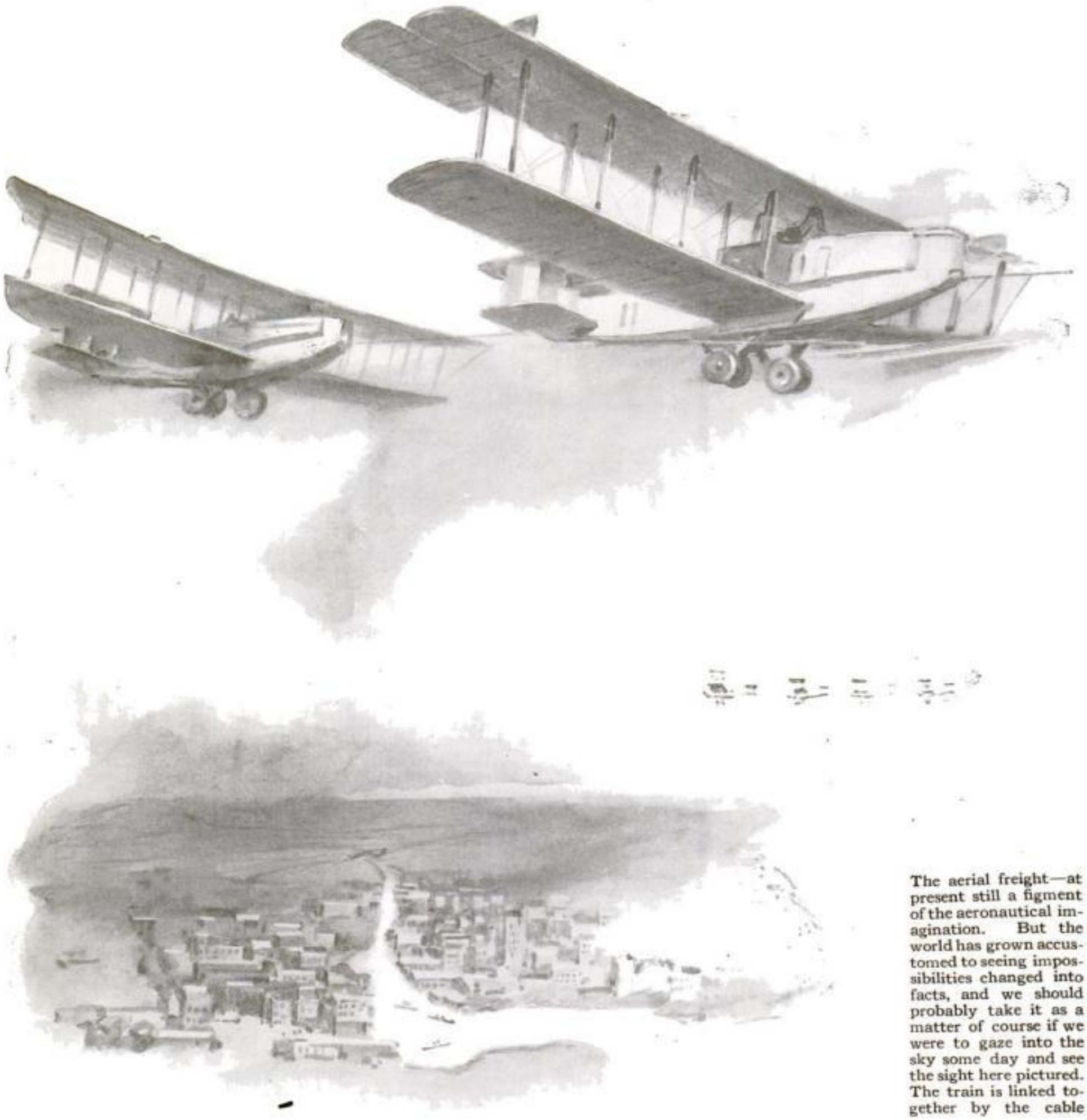
In chemical laboratories it is necessary to keep various gases in storage. Metal tanks have been used, but are expensive. The use of nurse balloons in the laboratory affords a convenient method of handling gas. Small gas-companies are also using the storage bags for the same purpose, instead of erecting expensive tanks.

The highly combustible na ure of illuminating gas would make it an unsafe experiment to substitute gas-bags for metal tanks where sparks or inflammable mater'al might fire the balloon. Means for providing sufficient pressure are also required in thi use of the gas-bag.

Next! The Aerial Freight Train

Will this latest project of aeronautics become a practical possibility?

By Adrian Van Muffling, S. A. E.

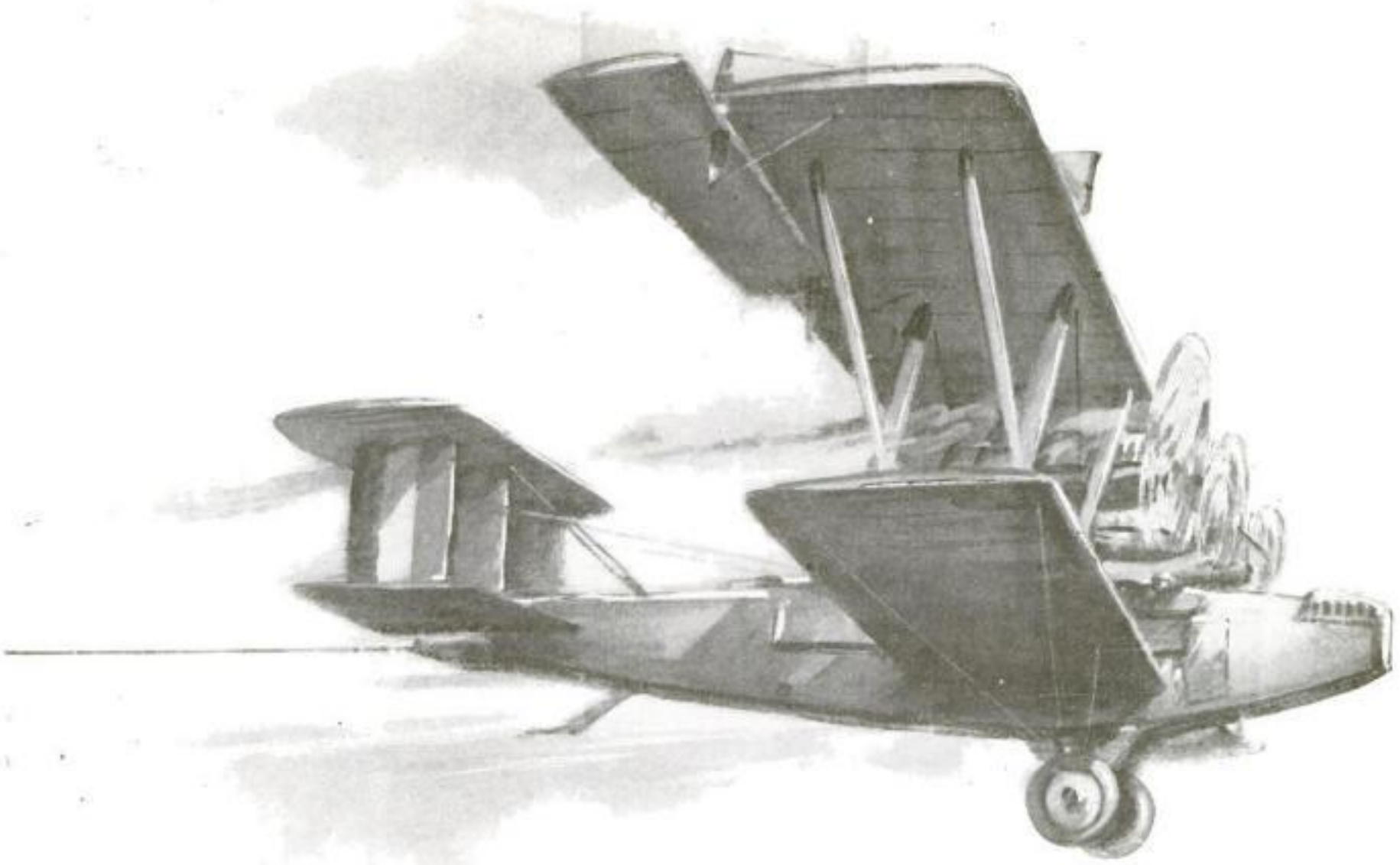


The aerial freight—at present still a figment of the aeronautical imagination. But the world has grown accustomed to seeing impossibilities changed into facts, and we should probably take it as a matter of course if we were to gaze into the sky some day and see the sight here pictured. The train is linked together by the cable

IMAGINE a string of airplanes, or rather huge motorless gliders laden with freight, traveling over the trackless road-beds of the sky, led by a tremendous "locomotive-plane." It's a picture fairly staggering even to our rather sophisticated modern imagination.

And yet, if reports from overseas are true, the scheme to employ an airplane of enormous power to pull a number of freight-carrying gliders is credited to no less experienced a man than Mr. Fokker, the Dutch aeronautical engineer who developed the first high-speed flying machine during the war and thus gave Germany a temporary supremacy over her foes. In justice to Mr. Fokker, it should be stated that he first offered his designs to the Allies, and did not enter into communication with Germany until he had been turned down by them.

The most obvious difficulty in trailing airplanes lies in the method of starting and getting the trailers off the ground. Will they be placed



behind one another close to the "locomotive," and start on their journey as the connecting cable becomes taut? Obviously this method would subject the frame of each unit to stress much greater than it can be built to stand; moreover, the imposition of sudden and increasing loads would result in slowing down the motor unit to below its flying speed. If, on the other hand, the planes were placed at a proper distance apart, with the cable stretched between them, a field several miles long would be required to get up the necessary speed. Two alternatives present themselves. One consists in starting the units closely grouped with taut connection between them that could be paid out gradually so as to increase the distance—a method that is objectionable because of the aerodynamic interference between the units. The other is to accelerate all trailing units simultaneously by means of a moving platform or endless chain, an expedient involving a disproportionate expense.

Another problem presents itself. Conditions in the air would vary materially between points as far apart as the various units necessarily would have to be. For an instant a trailer might travel a little faster than the one immediately preceding, thus relaxing the connection. What would happen when the slack was taken up?

The thought of having each "car" equipped with a reel upon which the cable could wind itself as required presents itself, the tension being kept constant by a compressed-air or spring arrangement after the fashion of the familiar trolley-pole retrievers. The weight of such an equipment would be likely to be equal to that of the average aviation motor.

Difficulties to Be Overcome

Even with the most careful individual control of all units, it would be a very difficult matter to keep them traveling in exactly the same path. The slightest deviation, on the part of the motor unit, from a mathematically straight line would entail a side-slipping effect on the succeeding units. Moreover, the tractive effort exerted by the cable in a forward direction would vary with each change in direction, no matter how slight, and at no time could a constant pull be expected for any extended period of time. That this would seriously affect the maneuvering powers of the train is apparent.

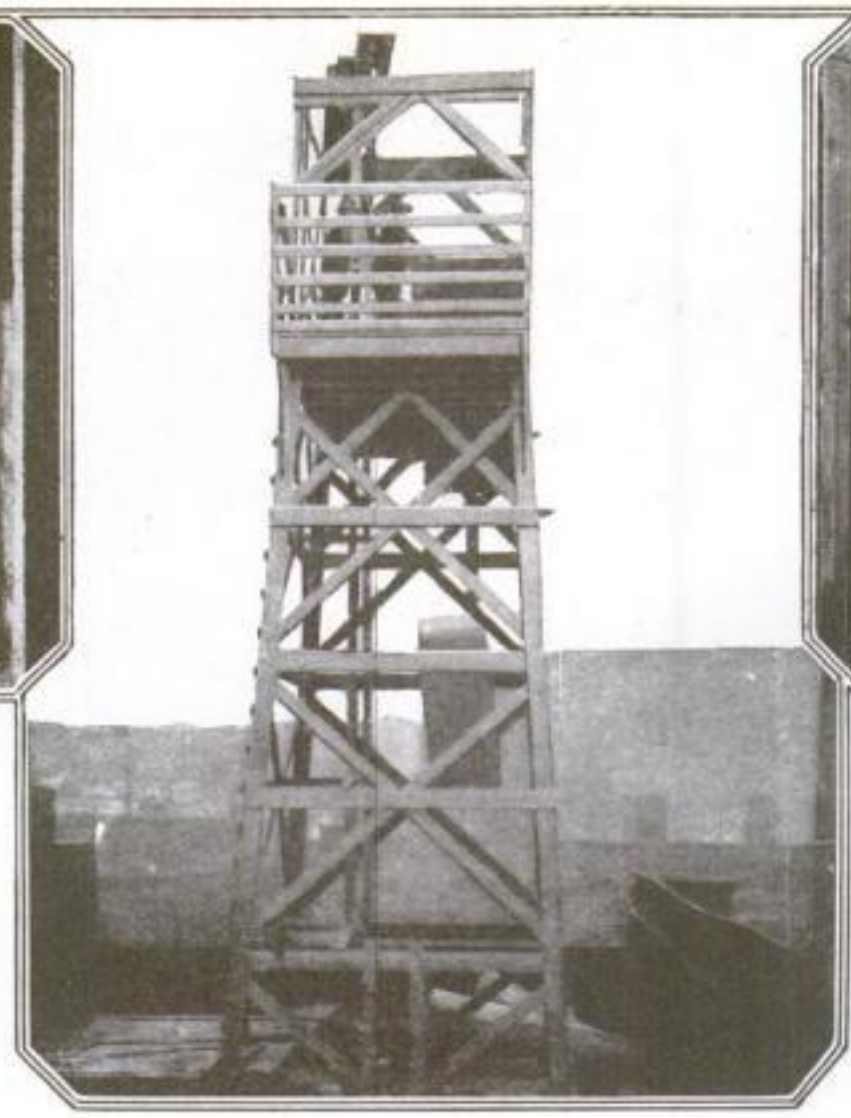
But the greatest difficulty to be overcome is inherent in conditions that govern the relation of power and weight in airplanes. The greater part of the power developed by an aviation motor goes toward sustentation; the rest is absorbed by resistance encountered in driving the machine. If the power be greatly increased the excess will go toward increasing the speed (and it requires roughly four times the power to double the speed). An airplane has therefore no "tractive-effort;" that is, it is inherently unsuited to exert a pull. Now, the motor unit would have to lift itself first of all—no mean achievement if we consider the weight and size of the power plant required, and in order to give any tractive effort the power developed would have to be far superior to that needed for flight, which is equivalent to saying that the machine should be able to keep itself in the air at a speed considerably less than that of which it is capable; a condition which has not so far been realized even in the most modern types of airplanes.

A Remote Possibility

The weight and resistance encountered by a large machine capable of carrying, say, five tons of freight would be much smaller (to a pound lifted) than that offered by five smaller planes of one-ton capacity, each involving a separate set of wings, struts, landing-gear wires, a second pilot, etc. Counting the weight and resistance of the motor unit necessary, but not carrying a "useful load," the power required seems to be at least eight times as much as if the entire cargo were concentrated into one machine capable of carrying it. This is another difficulty added to those mentioned.

These considerations lead one to the conclusion that the aerial freight train is a remote possibility.

A load of bricks was dropped on it; then it was baked again. Afterward the safe was still intact, but it looked like this



A safe was baked for two hours and then dropped from a height of thirty feet to the pavement

When it was opened at the conclusion of the test, the safe's partitions sagged, but its contents were unharmed

The trustful safe-maker was testing its strength and it went through the ordeal nobly to prove it

How to Test a Safe's Strength

A SAFE has a reputation to uphold. It is supposed to protect its contents so carefully that they will come through fire and falls unscathed. But how can you be sure of this? One safe-maker decided to prove the worth of his safes by baking one of them, dropping it thirty feet through the air, hurling a load of bricks on top of it, and then baking it again. Before he put it through this set of tortures he loaded it with books, magazines, and even some loose dollar bills.

In the first baking of two hours the temperature in the oven was nearly 2000° F. Thermo couples showed an interior temperature of 300°. When the safe was opened the books were found slightly warped, but no serious damage was done.

While it was still hot, the safe was thrown from a scaffolding thirty feet to the ground. A shower of bricks followed it. Owing to the heat, these dented the steel, but did no further harm.

The safe was rushed back to the furnace and baked once more, this time for an hour and a half. The temperature within the safe hovered around the three hundred mark all the while. When it was taken out and opened, the contents —books, magazines, dollar bills— were limp but unharmed. The partitions were sagging, yet unbroken. The safe itself was blistered on the outside and had a tendency to peel, but it was intact.

Who can doubt the excellence of this safe?

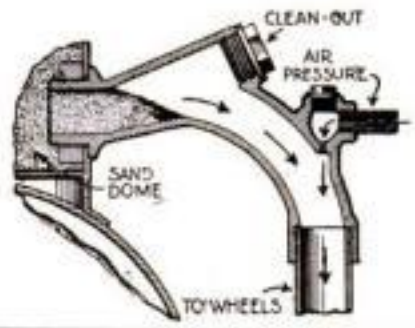
Sanding by Compressed Air

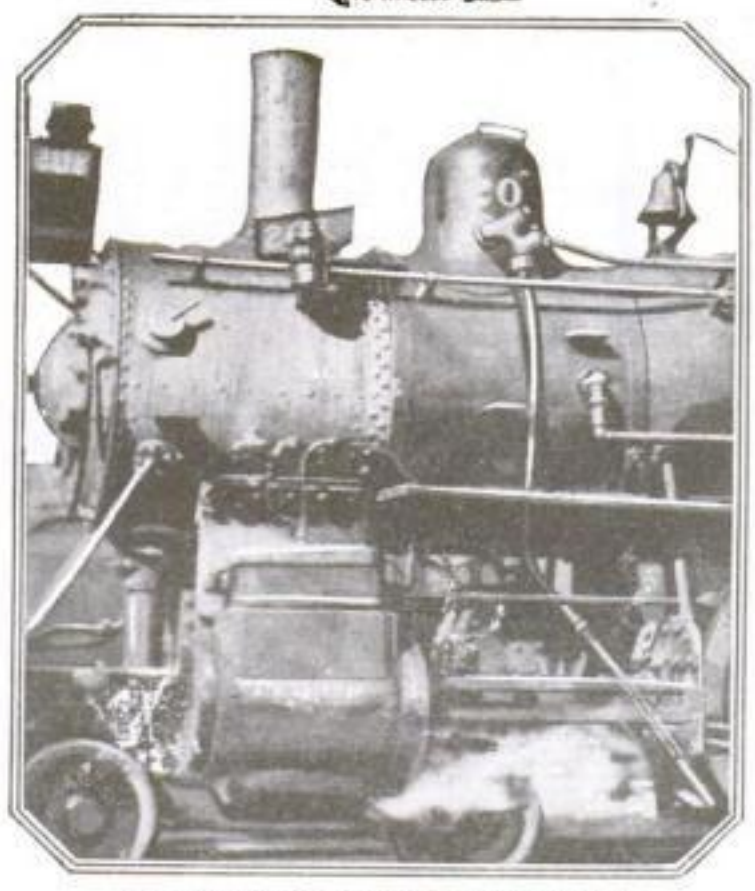
CHAINS keep an automobile from skidding and sliding when the brakes are jammed on in rainy weather. A train can't wear chains, yet it is just as susceptible when the brakes are applied and the tracks are wet. But a constant flow of sand from the locomotive to the tracks will take the place of chains.

Alva A. Fryer, of Kansas City, Mo., has invented a new sanding device that works on the vacuum principle and consequently insures a smooth, even flow of sand. The sand is held in a tank at the top of the locomotive. A feed-pipe that carries the sand from the tank to the discharge nozzle inclines upward slightly, and thus keeps the sand from pouring out until compressed air exerts its force. The compressed-air inlet is located at the top of the discharge-pipe. When the air is released the force of it drags sand to the top of the discharge-pipe and then speeds it on its way down to the tracks.

In the ordinary gravity type of sander the sand is very apt to clog and stop the flow, particularly if it is damp. Compressed air makes this impossible while it lessens the wear on the parts. The operation of this device is not affected by climatic conditions.

The sander is cast in one piece and is made of manganese iron. When it is necessary to clean it out or inspect the sand the "clean-out" plug shown in the illustration is removed. Even when sand is comparatively dry, it is apt to "bake" in the dome and must be stirred.





In order to prevent slipping, sand is dropped from the locomotive to the railroad tracks by a sanding device

This fire in a telephone switchboard was staged in somebody's back yard in order to show night watchmen how to put out fires

Wire-draped racks were erected at the fire-fighting exhibition. These were set on fire and the men took turns at putting them out

Learning to Fight a Switchboard Fire

IF a telephone switchboard caught fire, would you know how to put it out? Perhaps you are never left alone with a switchboard, but there are many men—watchmen, for instance—who are. For the benefit of these men the New York Telephone Company recently held a fire-fighting exhibition.

The company borrowed somebody's back yard and placed in it an old switchboard and racks on which pieces of junk wire were hung. First the watchmen were shown how to handle chemical extinguishers; then small fires were started in the racks. The men took turns at trying to put the fires out. They used pails of sand, to begin with, since sand would not do as much damage as water. If the sand failed to put the fires out, water was used. If neither of them was effective, chemical extinguishers were used.

When all the men had demonstrated that they could handle small fires, larger ones were started, and allowed to burn for some time before attempts were made to check them. In the case of the switchboard, for instance, a fire was started in the keyboard as well as in the wiring at the rear. The men were greatly interested in the exhibition and handled the apparatus very skilfully.

The exhibition took place on Fire Prevention Day and was well attended by central office employees and real estate watchmen. More than fifty men were gathered in the Brooklyn back yard, and several of them were given an opportunity to show their ability at fire fighting.

No More Trouble with the Machine-Tool Oil-Pump

IN cutting metals, the tools must be kept cool by means of oil in order to prevent the excessive heat generated by friction, from spoiling the edge. The oil must be pumped continuously upon the tool and the supply must be regulated to correspond with the cutting speed.

This pumping has been accomplished by several different types of pumps, some of which did not give satisfaction because they had to be primed each time the pump was started. Other pumps failed because they would become clogged by small chips of material getting into the pump-chamber.

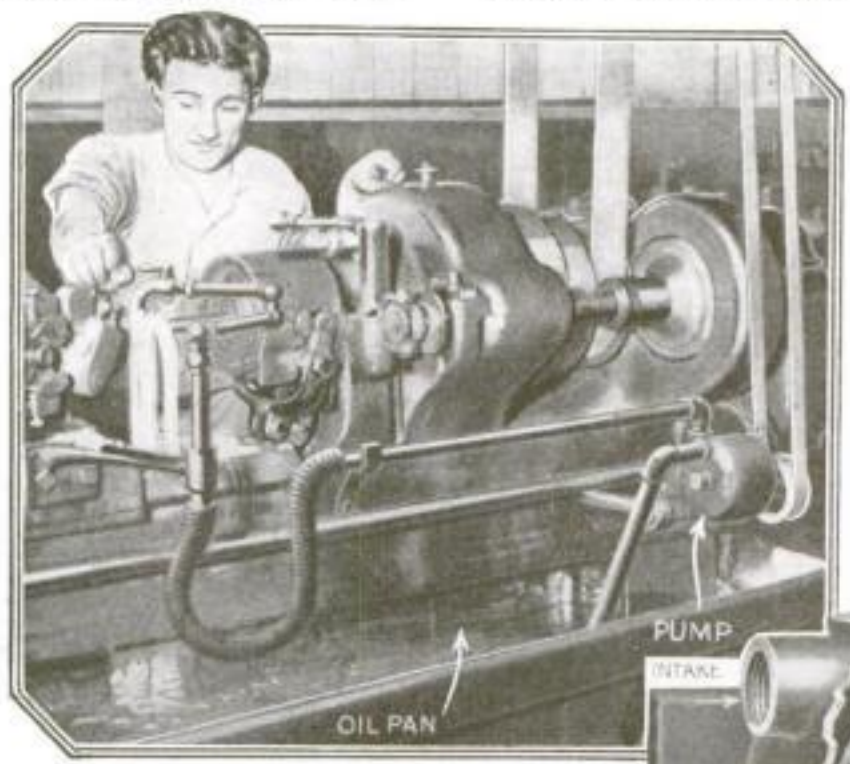
Both of these objections, which seriously affect the output of any cutting machine, have been overcome in the new type of centrifugal oil-pump shown in the accompanying illustrations. Both the intake and discharge pipes are placed at the top of the pump. This always insures sufficient oil in the impellor chamber to start pumping.

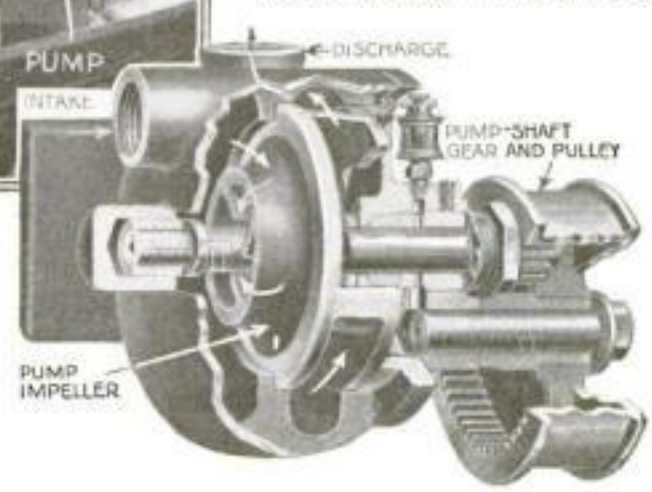
The objectionable clogging has been overcome by making no passages in the pump-chamber smaller than the inlet and outlet pipes.

Thus anything that can enter the pump, will also pass through it.

Full pumping efficiency is secured because the impellor, the only internal working part, does not depend upon contact fits for its operation. Furthermore the outlet of the pump may be regulated to give a flow of fifteen gallons a minute, or it may be choked off to a single drop.

The position of the intake and discharge pipes at the top of the pump does away with the necessity of re-priming the pump.

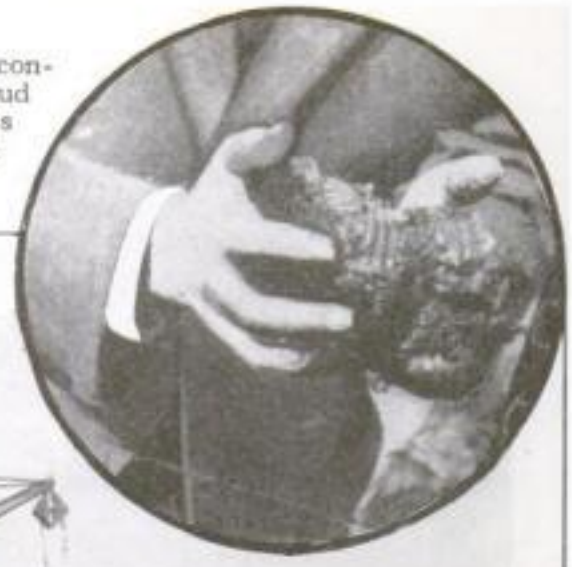




This pump for cooling tools by a constant flow of oil has its intake and discharge pipes on top; thus constant priming is unnecessary. Its flow may be regulated to fifteen gallons a minute, or to a single drop according to the requirements of the work. There is no clogging since no passage in the pump is smaller than the inlet and outlet pipes

Will Peat Ever Replace Coal?

As coal grows scarcer a machine for excavating peat is invented



You would hardly consider this slimy mud valuable; yet, this mud may be the fuel of the future

Peat is formed by the partial decomposition of plants in water, and is found in damp, marshy places. This new excavating-machine digs it up by means of buckets on an endless chain. The machine moves slowly along the top of a trench scooping peat from the edges

When the buckets go over the top the peat drops into a tank, where it is thoroughly mixed and pressed. Then it is dumped into a conveyor and carried off to dry. With the aid of this machine twenty-five thousand tons of peat, cut into neat bricks, can be turned out for fuel each year

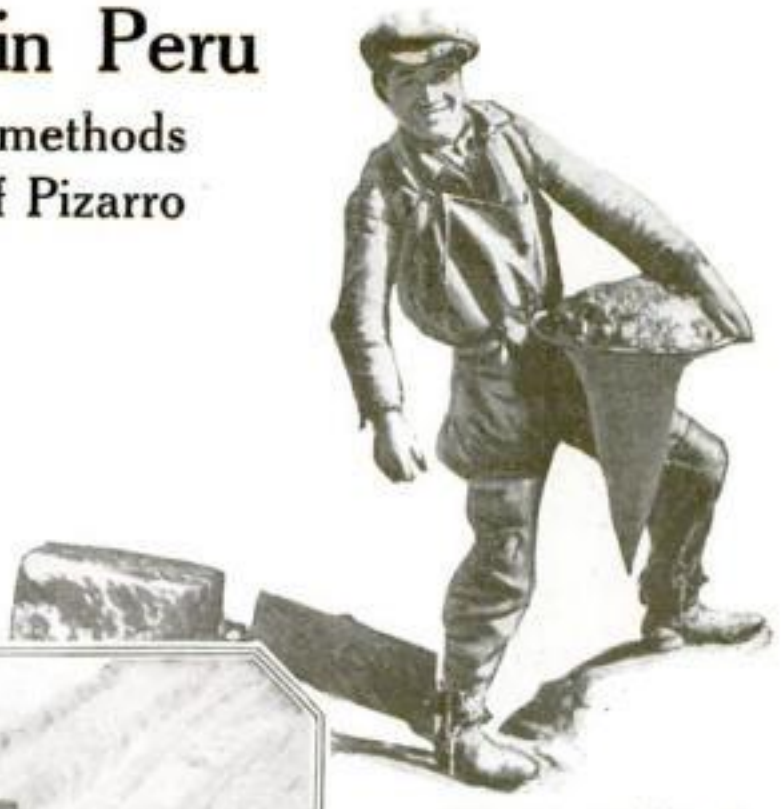
While the buckets on the endless chain scoop up the peat, this string of trucks carries it to the drying-field. The trucks are mounted on tracks and are propelled by a gasoline-driven motor-car

This is the conveyor that spreads the peat out to dry. The peat is divided into rows by knives at the ends of the conveyor. When it is dry it is cut into bricks for fuel

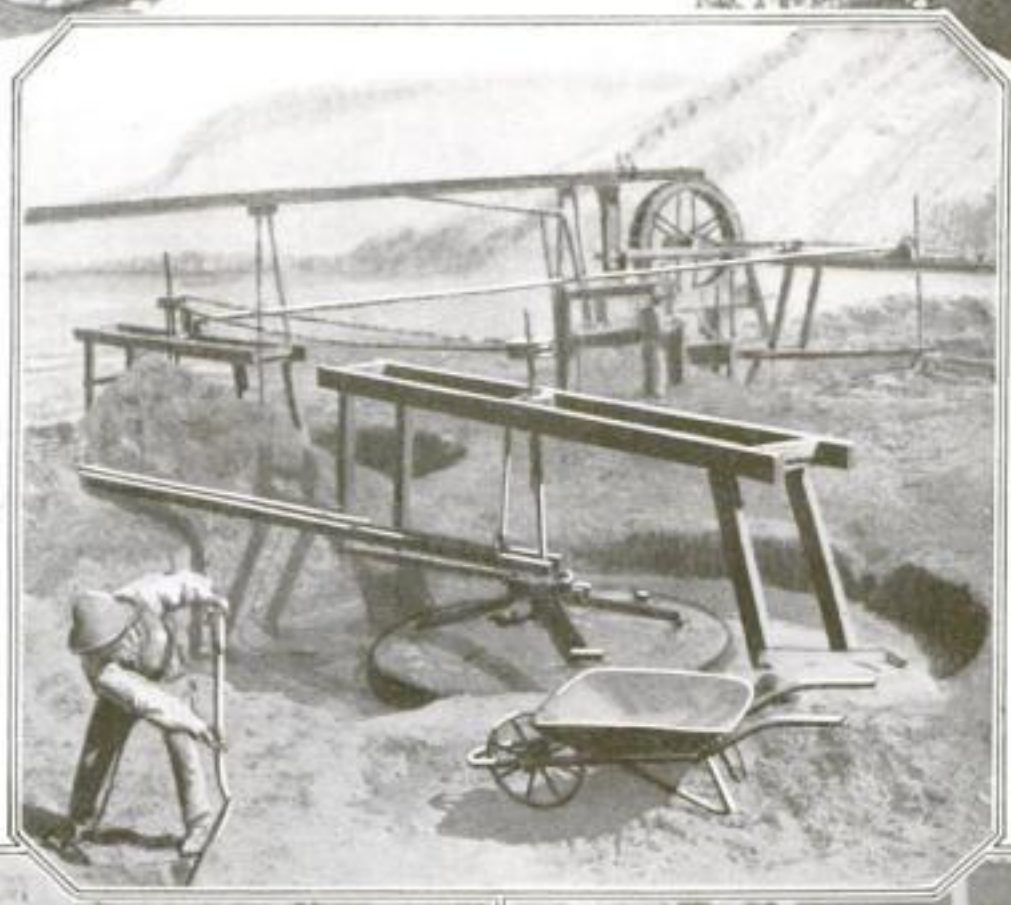
The Way They Mine Silver in Peru

They still employ the primitive methods that were in vogue in the days of Pizarro

The ore is crushed by huge boulders that natives rock back and forward. Handles are loosely attached to the boulders and they enable the men to work with ease. Peru has none of our labor troubles. Laborers are plentiful and they are willing to work

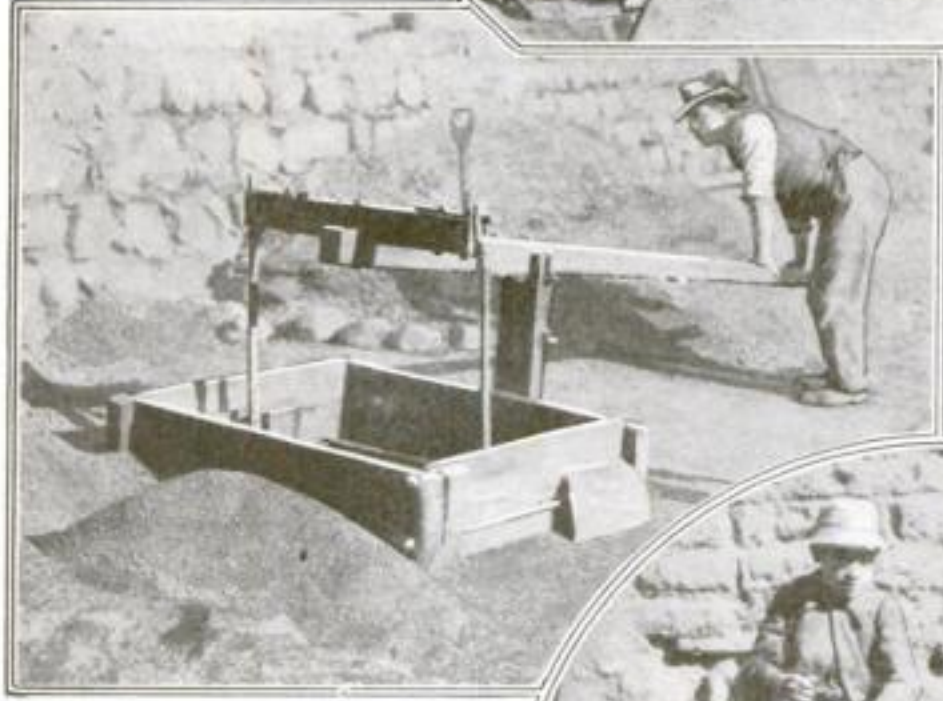


When the mud has almost disappeared from the ore, the remaining silver paste is placed in cone-shaped bags of heavy sacking, to remain until most of the water has dripped through an opening in the bottom



When the rolling stone has thoroughly crushed the ore it is dumped into a cylindrical tank about five feet deep and then water is added

A revolving wheel in the tank stirs the water and crushed rock together until they form a thick mud which is very rich with silver



From the tank the ore mud is removed to a square box with a fine screen bottom. By pressing a lever, the workman drops the mud-filled box into a tank of water. The mud becomes diluted and the fine silver dust drops through the wire screen

The silver dust clings to the mud, and a second bath follows in a ditch of running water. Again the silver drops to the bottom and the lighter mud is washed away

The moist paste is finally spread out on the ground to dry. Then it is shoveled into large canvas bags, sewed in and carefully weighed. It is now ready for shipment to European smelters

The Motor-Truck Helps the Railroad

Speed up the box-car by the expedient of keeping it moving

By Latimer J. Wilson

IF the man whose income is but $1,300 a year knew that he is paying a tax of $80 a year, what would happen? The answer is obvious. But he does not know, and so he goes on paying $80 a year tribute to the box-car that hauls his food, clothing, and other necessities. This tax does not help to produce the necessities of life, nor does it benefit the railroads that bring the food to the city. Each year this tax reaches the huge total of more than $1,000,000,000 for the 20,000,000 families of the country.

What is the reason for this loss? The modern freight-car. Compare the prairie-schooner of the '40's with the box-car of today, and you will find that a good team moved freight with 1.24 per cent. less efficiency than the car does today. A load of freight can be brought by rail 900 miles from Chicago to New York at a cost about equal to that of handling the same load from the railway terminal through the streets to the consignee.

Freight Is Stacked at Terminals

Inbound freight from Staten Island and New Jersey freight-yards costs every man, woman, and child in Manhattan almost 6½ cents a day, amounting to about $118 a year for each family of five. Two-thirds of this could be saved, and the cost of the necessary installation paid out of the first year's savings.

Since 1918 there has been a great decrease of mileage made by loaded freight-cars, due to the shortage of cars. The box-cars that should be used to carry freight from one city to another are held for the storage of freight because of the tremendous congestion at the terminals of the railroads. The terminal costs are enormous compared with the transportation costs in every city. This fact stands out when we consider short-distance hauls. The actual transportation cost from Philadelphia to New York, based on a maximum charge of 6 mills a ton-mile, suggests a cost of 60 cents compared with a joint terminal cost of $6!

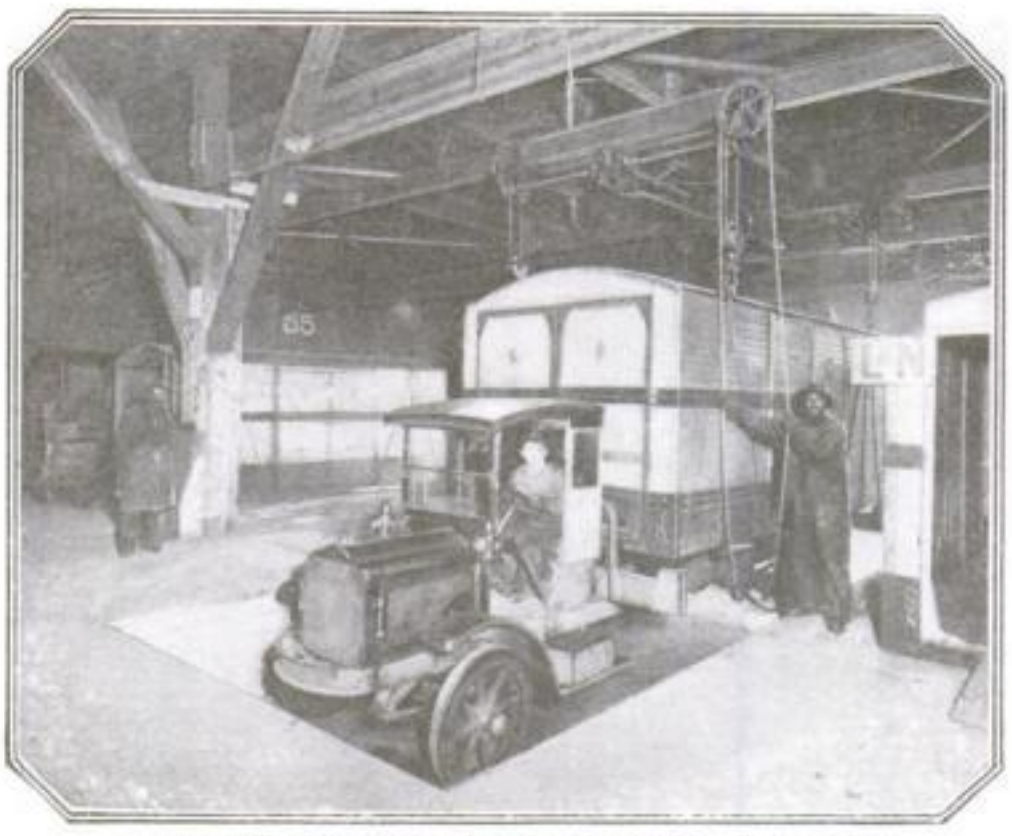
Instead of traveling at the rate of 20 miles an hour for 14 hours, making 280 miles a day, the average box-car covers only 26 miles a day. This is little more than an hour's work as a vehicle of transportation. Railroad practice figures that a car will be idle ten hours a day, which leaves fourteen hours of usefulness. But the actual handicap imposed upon the car by modern methods of freight-handling allow it only one hour instead of fourteen as a carrier of material from city to city. The box-car is turned into a storage-room or a "transfer" to be switched about in the terminal yards.

The Why of the H. C. of L.

Do you know that it costs every family of five in New York city $118 a year because of New York's hopeless freight congestion?

What can be done about it? Let the motor-truck help the railroads. This is the first of a series of articles that the POPULAR SCIENCE MONTHLY will publish from month to month on business uses of the motor-truck.

The truck-bodies are unloaded and the contents checked from the telephone despatch which was received before the demountable body arrived



A demountable body being placed upon the truck which has driven into the "slip" especially adapted to receive trucks. Working height is gained by the lowered floor

Why There Is a Car Shortage

Every large city has many railroad lines passing through it. For convenience, consider a city that has but seven non-competing lines. A freight exchange is taking place every day from one main terminal to the six other main terminals, making a total of 42 cars in the transfer of freight. Let each line have but three sub-stations,—a very conservative number for a large city,—and there is a transfer between these stations and the main terminal, which keeps 21 cars going and 21 cars coming each day, a total of 42 cars. Add the two, and we see that 84 cars are involved. This transfer delays freight in the terminal yards three days or longer. This is an equivalent of 252 cars. Think of the number involved where cities have 20 or more sub-stations!

The floor-space occupied by boxes, barrels, packages of necessities of life, or the machines for industry, or the tools for labor, on the station platform is an average of 200 square feet to the ton, or a maximum of 290 feet. The box-car transfer delay is 72 hours. If loaded

to 9 tons it requires an average of 8 hours to move one ton from one station to another. When each of the 7 connecting lines has three stations, 42 cars cause the delay of 37,800 car-days. Hence the apparent shortage of cars.

Spending Millions Isn't the Answer

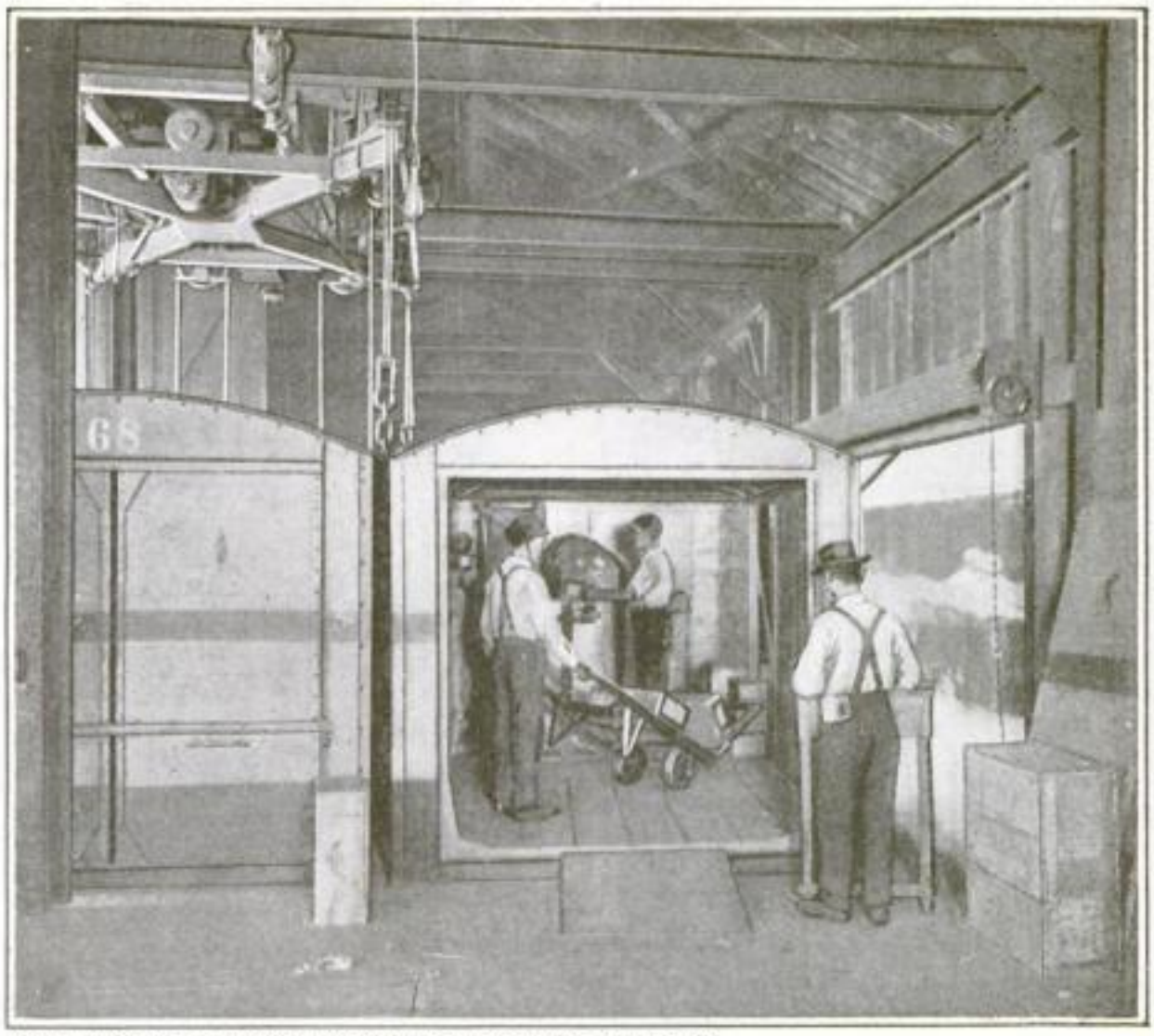
If the railroads could afford to scrap their present investments and spend from $50,000,000 to $500,000,000 in building huge central terminals, the problem, for the time being, would be solved. But as cities continue to grow these terminals would ultimately be inadequate. What is needed is an elastic system.

One man in the United States has come forward with a practical plan. He is Benjamin F. Fitch. His plan has been tried on a large scale in Cincinnati, Ohio, and found practical. Strange as it may seem, Mr. Fitch's plan does not displace thousands of miles of tracks nor demolish acres of buildings. The old freight-house built half a century ago, as well as the latest terminal station, is substantially a part of the scheme. Here and there a few inexpensive structures are added.

Motor-Trucks to the Rescue

The secret of Mr. Fitch's success is the creation of a continuous transfer service. City streets, country roads, all become a part of his transportation plan. The railroad track system, which of economic necessity must remain fixed, is opened to traffic for the actual transportation of material over through routes. The box-car as a transfer car vanishes, and the motor-truck takes its place, working from the outside.

The railroad managers of Cincinnati, after considerable study, concluded to adopt the Fitch motorized system. They figured that 66,862.5 cars would be released for through service; that 21.4 per cent. trackage would be released at the main stations; and that 122,660 square feet of increased realty would result. Inbound platform space would be increased 14.8 per cent., and outbound space would be increased in proportion to the operation of the station. There would be no congestion of freight, because the motor-trucks would keep up a continuous movement. To do this the stations had to be adapted to the particular requirements of their location, original construction, etc. Every detail that would permit the rapid movement of the motor-trucks was considered. The predicted saving was $61,652 annually, but in practice double the saving resulted.



Courtesy Material Handling Machine Manufacturing Association

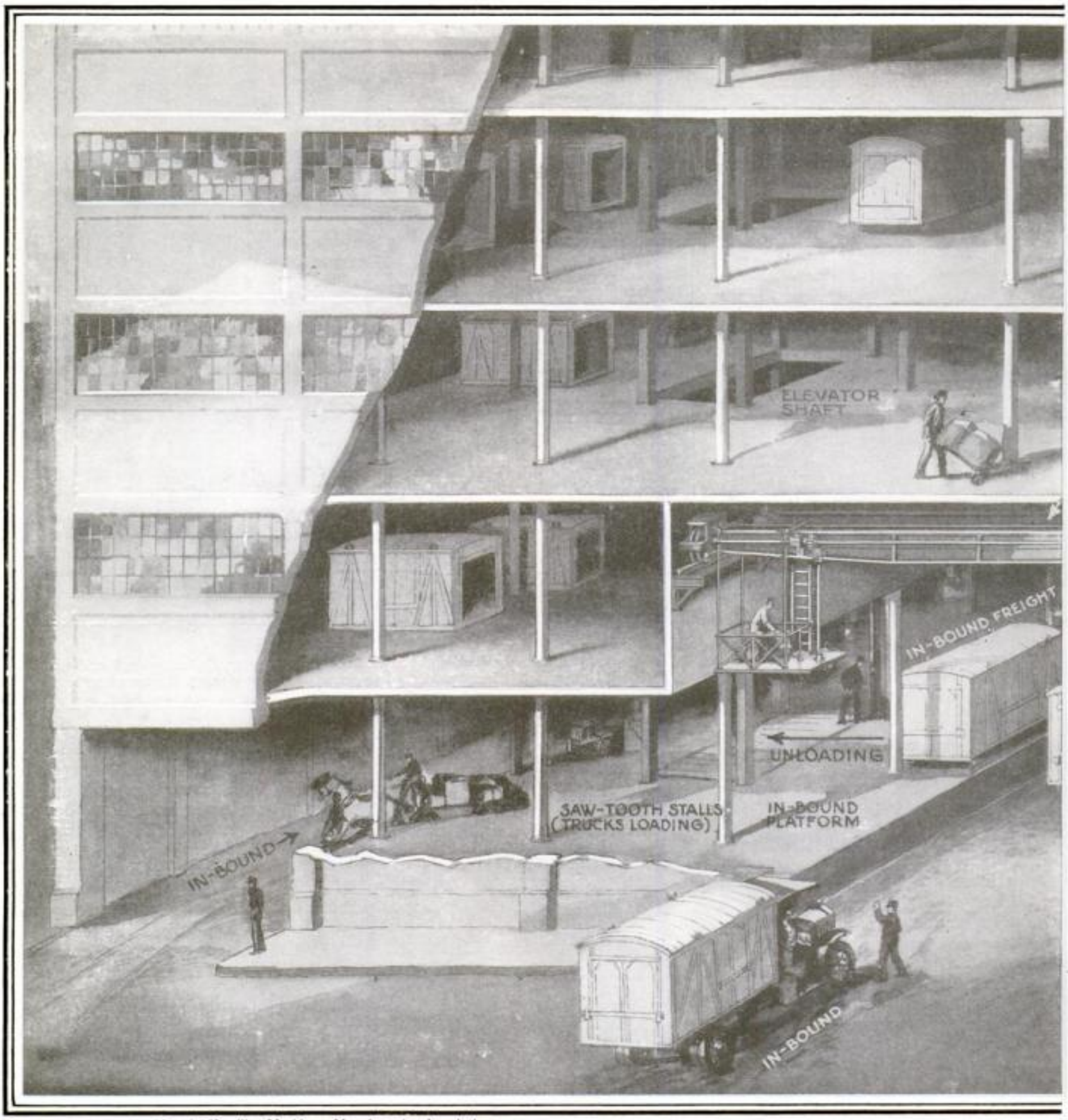
A demountable body having been hoisted from the truck is lowered and unloaded, the freight being transferred to other bodies to be routed over other lines

A demountable truck-body being loaded preparatory to sealing and routing to a sub-station or to one of the main terminals for through routing

Every motor-truck used in the system has a number of demountable bodies of steel and wood. The inside dimensions are 17½ feet long, 8 feet wide, and 7 feet high. The capacity is 10,000 pounds. There are interchangeable side and end doors, equipped with protection bars and sealing devices. The terminals and sub-stations are equipped with electric hoists.

In operation a truck from which an outbound loaded body has been removed draws into its assigned location, and a loaded body is quickly moved into place and lowered upon its frame. Telephone despatch precedes the departure of the truck from the terminal, and by the time it arrives at the sub-station its contents are known. The body is deposited upon the platform at the exact spot prepared for it. The truck is instantly ready to receive a freshly loaded body, and is driven around to the place where the exchange freight has been sealed for transfer. The motor-trucks do not stand in line, waiting to be unloaded; they merely have to wait for the exchanging of their bodies. The average trip time for the average body load of 4.37 tons is 10 minutes. Computed on a car basis, the movement is one ton every 2.3 minutes.

New York City's great problem at present engrosses Mr. Fitch. His solution of it considers the future. Thirty thousand tons of material daily are moved from Staten Island and New Jersey terminals to Manhattan; 20,000 tons a day move out through these terminals. It is estimated that an average of two-thirds of the cost movement of inbound freight could be saved if the plan of Mr. Fitch is carried out. This saving



After data supplied by the Material Handling Machinery Manufacturing Association

Here is a section of the ideal terminal building. The slips are so arranged as to afford the maximum efficiency of truck movement. The trucks come in on one

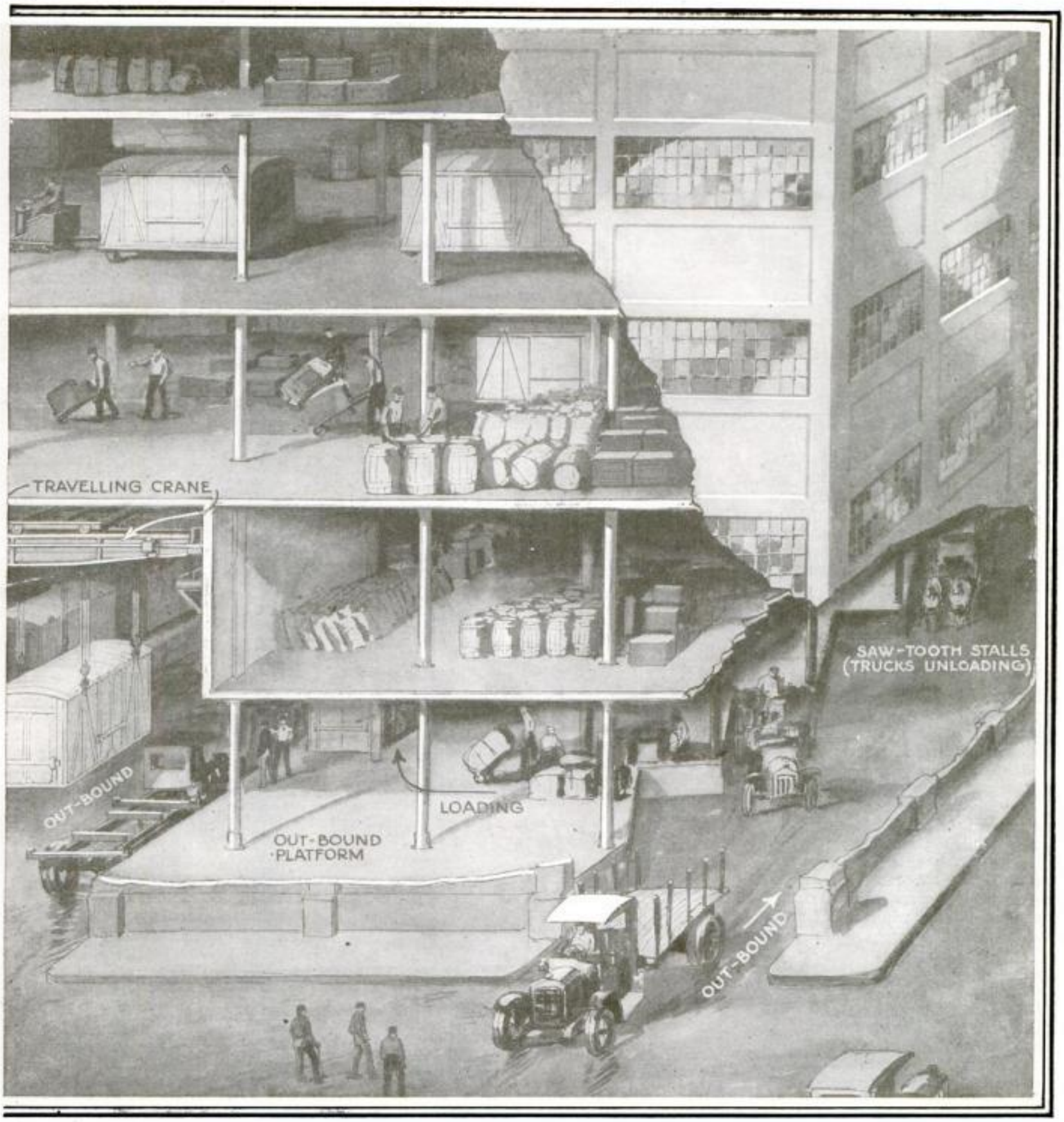
in one year would pay for the installation of equipment, not including the cost of terminal buildings.

Mr. Fitch would arrange Manhattan in twelve zones, each of which would have a joint inland station, situated conveniently near the slip from which its freight would be received. The rail bulkhead terminals in Staten Island, New Jersey, and the Bronx would each have a system of stations so linked that freight could be moved freely by motor-truck from one to another. Inbound freight would be taken from the box-cars and put into demountable bodies of trucks and sent to the point of despatch nearest the Manhattan terminal slip. Outbound freight would be handled similarly. This would put into free movement the numbers of box-cars that are now delayed by their trips across the river to the piers where great congestion prevails.

Saving New York from Herself

Based on what has already been demonstrated in Cincinnati, it can be prophesied that the rates for the motorized interchange of freight will certainly not exceed $2 a ton between the transfer stations at the rail bulkheads and the inland stations in Manhattan. Such will afford short hauls for the shipper, the cost of which will be about $1 a ton, making a total cost of $3 a ton on material inbound and outbound from Manhattan. The present joint cost is not less than $6 a ton, so here is saved $3. If one considers the saving on the inbound freight and deducts this from the cost of food, then Father Knickerbocker should be able to save his box-car tax of $80 a year. This sum totals $45,000,000 as a net saving for shipper and consumer.

The inland stations could be built on less valuable realty that is far back from the valuable water-frontage. The buildings themselves could be made impressive structures. The lower floors would serve for freight-handling,



side, discharge their demountable bodies, and go to the other side to receive loaded bodies. All of the "through routed" freight is sent through the central passage

while the upper floors would be rented to industrial plants, which would be glad to find occupancy near a terminal. These rentals would soon make handsome returns on the investment. Sufficient truck-bodies would be furnished all the stations to meet the full demands.

Perhaps special ferries would in time be built to accommodate the numbers of motor-trucks bodies that must be brought across the river to Manhattan. Vehicular tubes connecting the island with the mainland will soon be built.

In the system of direct routing afforded by the plan set forth by Mr. Fitch, instead of 1,514 miles of city streets being traveled to distribute freight from the Thirty-seventh street yard of the Pennsylvania Railroad, the same material would be carried only 703 miles. A saving of fuel and wear on the motor-trucks will be the outcome of the twelve-zone system.

To Make a Greater Port

Today every pound of freight coming into Manhattan and every pound that is taken from the city must be carted through city streets. Long trips are made to the ferries or present terminals, filling the streets with vehicles, some of which are only partially loaded. This causes great congestion of traffic and enormous waste of space. The short hauls afforded by the twelve-zone system will work every truck to its capacity on every trip through the streets. Instead of having many conveyances carrying short loads of freight, there will be a fewer number of vehicles to crowd the streets, but all of them will be doing their full duty.

Instead of 30 per cent of the piers of Manhattan being used by the railroads for freight stations, all of the city's port facilities will be used for coastwise and oversea shipping. This will enable New York to make the most of its location as a national port.

Ford tractors are hitched to the broom part of old street-sweepers, six of these trucks doing the work of twelve teams. Water is carried in a tank, to sprinkle the street before the broom

Hitch the Street-Sweeper to a Ford

PUT the old horse out in the pasture and hitch the street-sweeper to a Ford, and it will save money for your city. This is the lesson taught by the motorized street-cleaning department of Albany, N. Y. Horse-drawn sweepers, and also man-power sweepers, have been supplanted by the motor-drawn apparatus.

The change was wrought by taking away the front wheels of the horse-sweepers and connecting the sweeping part of the equipment with the tractors by means of a horizontal wheel or turn-table. This permits a flexible movement in the broom-trailer when the street corners are turned. It was necessary to change the gear or driving sprocket for the broom, to prevent it from revolving too rapidly with the increased speed of the motor-drawn apparatus. Pulled along by an old horse it turned slowly enough, but when gasoline furnished the motive energy the broom needed a speed regulator.

A strip seven feet wide and from twenty-four to thirty-three miles long can be swept in seven and one-half hours with an average speed of five miles an hour. It is estimated that about twelve teams are displaced in sweeping and sprinkling by five motor sweepers. The saving of time and labor as well as expense, is important.

The sweepers carry a water-tank with a capacity of one hundred and seventy-five gallons. A pipe runs from the tank along the side of the car and terminates in a sprinkler in front of the rear wheels. A sand-spreading wagon is also hitched to a motor-truck for distributing sand where needed, and in the motorized equipment of Albany there is also added a street-flushing system.

With the entire equipment a street may have the dust laid, then be swept clean, and afterward sprinkled, all in a single trip of the motorized "sweeper." Where flushing is required, the sprinkling apparatus is readjusted to give a heavy flow of water, and the "sweeper" accomplishes this detail with its other work.

This little tractor is here pulling a cultivator; but it will pull nearly anything else just as well

A Tractor for the Small Farmer

A NEW tractor that does the work of five men or one horse is shown in the illustration pulling a cultivator and jogging along at a good speed.

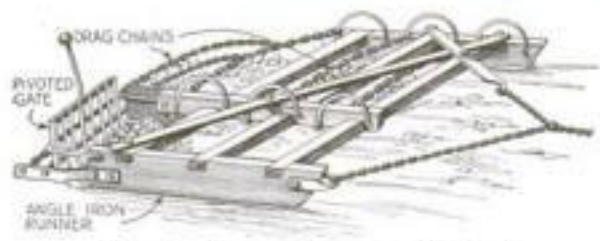
The belt-wheel seen in front makes it possible to use the six-horsepower engine for other power purposes than harrowing, seeding, etc. It may be run at high or low speed and will operate a saw, a pump, a sprayer, a dynamo, a cement-mixer, a fodder-shredder, a grindstone, a separator, a hay-fork, and numerous other pieces of farm machinery. And, what is more, it rolls from job to job on its own wheels and under its own power.

This iron horse eats only when at work and requires no attention when not on the job. It costs only a little more than a horse. Although designed primarily for the small farmer, it will be found exceedingly useful on the big farm. The advent of this tractor marks one more step toward increasing the production of the nation.

The small increase in cost of the new tractor is soon repaid through the amount of labor it saves. Also the driver may hasten the speed of an iron horse without a whip or the expenditure of energy in urging it forward, and the speeding up will not fatigue it.

The tractor's engine may be adapted to a variety of work.

It Gathers Up Stones in the Road



Chains form a heavy net that sweeps the roads for stones

WHERE large and small pebbles are collected loosely in the gravel of a road, they are usually scattered in such a way that it would be an irksome job to collect them by hand.

A new stone-gathering machine is drawn by one or two horses. A series of chains dragged loosely along the road sink into the small depressions and gradually scrape together the pebbles or stones. The obstructions are then drawn into a pocket, from which they are deposited at intervals in piles at the side of the road.

A pile of a hundred or more stones represents the work of only a few minutes, when gathered by this machine. How much time would it represent expressed in terms of man-energy? One hundred stones spread over an area of 400 square feet, in a plot 20 feet square, places one stone in every 4 square feet. A man working at average speed could pick up these stones and pile them at the side of the road in ten or fifteen minutes; but the machine with its dragging chains will do the work in a moment.

The dragging chains of this stone-gathering machine draw in the loose stones, which are automatically collected in a pocket. When the pocket is full the rear gate opens and the stones pile up at the side of the road

A lone hermit carved these queer stone figures in the shelving, rocky shores of the island of Rotheneuf, France, where he lives

Even the stone wall at the entrance to the hermitage is decorated with heads that the hermit carved in leisure moments

Stone Carvings by a Lone Hermit

IF you believe in ghosts, then go to the island named Rotheneuf, in France. It is such a weird, unearthly place that your chances of seeing a ghost there ought to be good. A hermit has lived there for many years and he has carved hundreds of strange figures in the shelving, rocky shores.

They look like petrified men, and most of them lie on their back staring at the sky with sightless eyes. They are supposed to represent Biblical characters, but as portraits they are decidedly unsatisfactory. In their crude art they suggest the carvings of pre-historic Egypt, or stone figures of the Aztecs unearthed in this country and in Mexico.

The entrance to the hermitage itself is a rough stone wall on which are mounted heads—not real ones, but stone ones—all of them labeled. They are grotesque and might easily be taken for gargoyles.

But the figures on the rocky hillsides are really the ghost-getters. Those that are not lying down are sitting up in more or less startled attitudes. A few figures stand on the hill-top. You can stand there with them if you climb the rough stone steps.

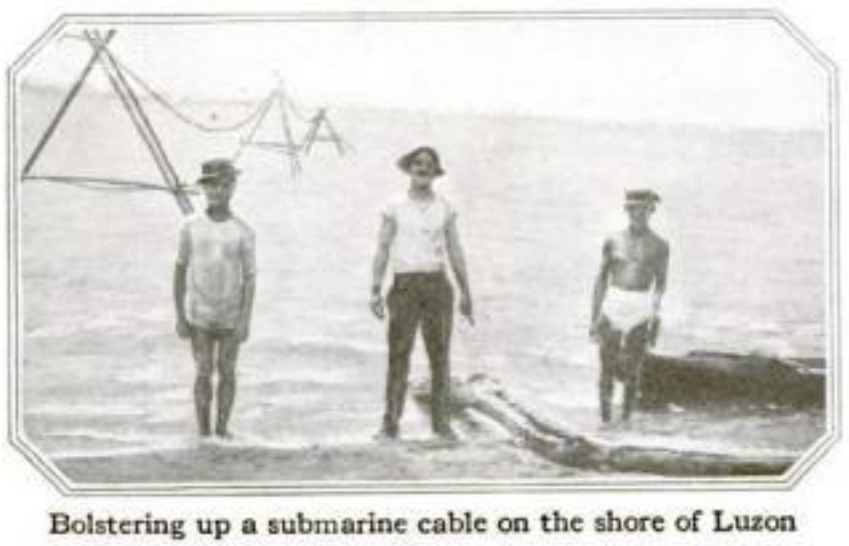
At the top of the steps, the hermitage stands, overlooking the strangely carved shore and the sea.

Many visitors come to the island to view these carvings which the hermit keeps swept free of sand accumulation. But who will care for them when he is gone?

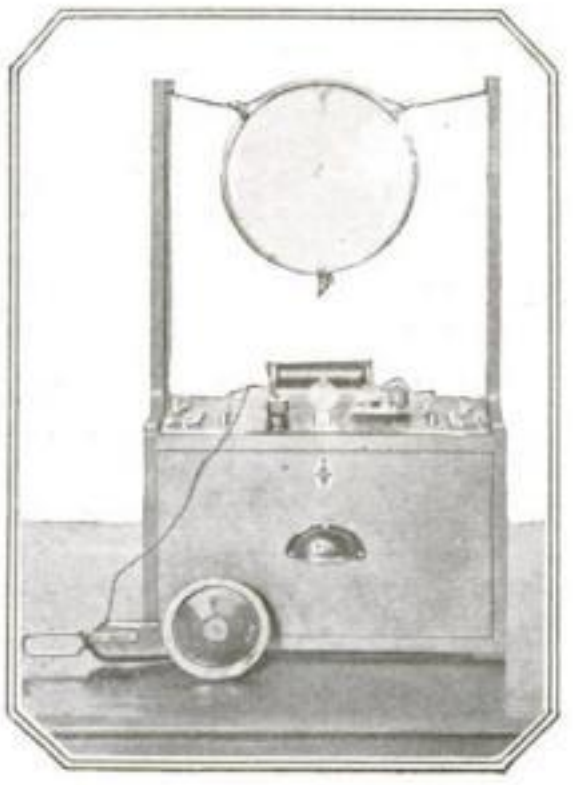
It is possible that in future ages they may be discovered under layers of sand and geological deposit and solemnly regarded as examples of twentieth century art!

Cable Repairs

WHEN the submarine cable leaks, a call goes out for the big cable repair ship to repair it. Bringing the cable-ship costs considerable money. The telegraph operator at Guinayangan on the island of Luzon has trained his native crew to raise the undersea wire without its aid. He contrived an ingenious set of props to hold the cable free of the water.



Bolstering up a submarine cable on the shore of Luzon



A small mirror, marked by vibrations of a membrane with which it is in contact, makes these vibrations visible by throwing a design on a screen in a darkened room

The apparatus pictured here, visualizes sound vibrations by variations in the intensity of the glow of a small electric light and by rhythmic fluctuations of sound vibrations

Hearing With the Eyes

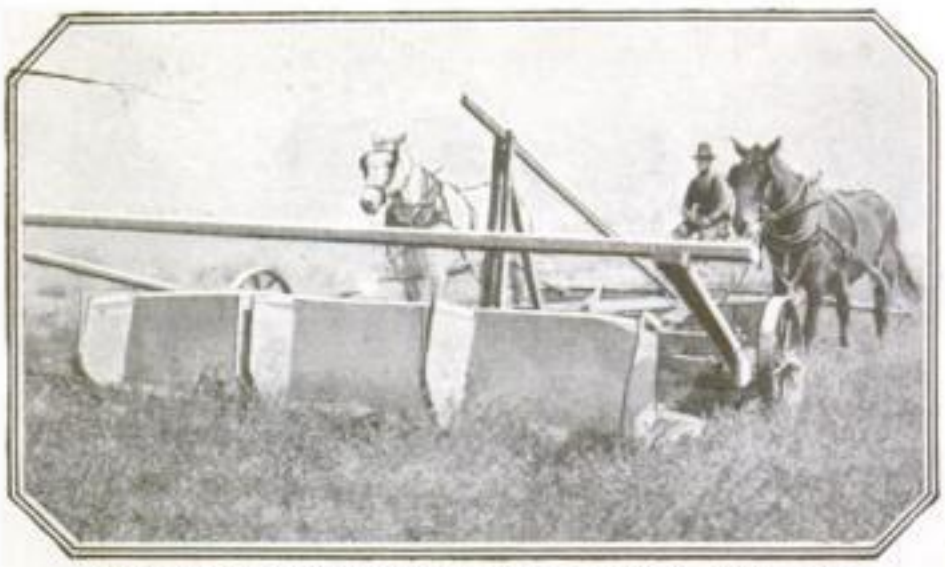
DEAF-MUTES, if they are not suffering from a structural defect of the organs of speech, may be taught to speak, but their instruction is difficult and its progress slow. It has been facilitated by the invention of Mr. Lindner, instructor of deaf-mutes in Leipzig, who, assisted by the Institute of Physics of Leipzig University, has evolved two instruments for visualizing the sound of human speech.

One, called a "vocal phonoscope," has a circular frame over which a thin membrane is stretched. A metal plate attached to the membrane bears a pointed pin or thorn. Against this pin rests a small plate of brass.

The apparatus can be used only in a dark room. Words spoken into the funnel cause the membrane to vibrate. The vibrations are transmitted by the pointed pin to the brass plate resting against it. This plate has a tiny mirror attached to it, upon which a ray of light is focussed. As the mirror is moved by the vibrations of the membrane, the ray of light, reflected by it, draws designs on a screen. The same sound, of the same volume produces always the same design.

Deaf-mute pupils soon learn to recognize sounds by the designs.

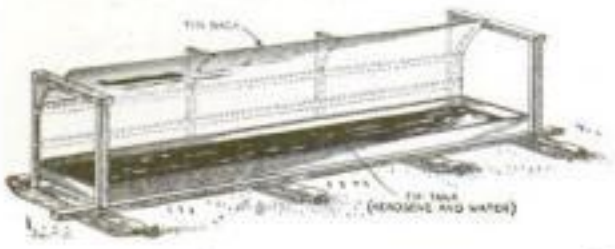
Another apparatus, the "drum phonoscope," does not require a dark room for its successful employment. A small drum is suspended from two vertical supports. By means of a delicate electrical contact the vibrations of the membrane of the drum are transmitted to a small incandescent lamp fed by a battery. The variations in the intensity and in the rhythm of the glow are interpreted by the pupils and are used, by comparison, as a means of correcting their own sound production. They soon become expert in producing similar variations.



He's catching grasshoppers with a hopperdozer. As he goes forward, the grasshoppers jump into the pan

Scooping Up the Grasshoppers

WHEN you go on a grasshopper hunt you can catch the bugs by the bushel with very little trouble if you copy the man in the picture. He drives a leisurely team of horses across the field and they push before them a "hopperdozer." Into it hundreds of grasshoppers drop every minute and drown.



A "hopperdozer" is not so complicated as it sounds, being a mere pan for holding water, with a wall around three sides.

Spotting an Airplane by Sound Waves

He's listening to the hum of an airplane's motor to locate it

A DEVICE has been invented for locating an airplane at night by the sound of the engine. It consists of two vibrating planes mounted at a slight angle to each other on a revolving wheel. A sound wave receiver is attached to each plane and is connected with a corresponding ear piece. The operator adjusts the ear pieces and then moves the wheel back and forward. When it reaches the region where the sound is most intense, the operator knows that he has found the direction in which the airplane is located. He continues to move the wheel slightly until the intensity of sound is the same on both sides of the device. He has then found the plane in which the airplane moves, and it is a simple matter to send a searchlight over that plane until the airplane is located.

The device may also be of use when the heavens are obscured by clouds and an airplane sails serenely out of sight in the clear ether above. The exact plane in which it moves may be ascertained.

Building an Excavator on the Spot

CONVERTING a stiff-legged man into an acrobat would be a transformation scarcely more interesting than the changing of a "stiff-leg" derrick into a "drag-line" excavator. Having a mile and one half of concrete railroad embankment to build, William McIntosh, master mechanic, hit upon the idea of making use of the discarded stiff-legs from a steel derrick. He had them rebuilt into "booms" for the drag-line. These were 62 feet long and 20 inches by 20 inches square in the center.

With two of these improvised excavators the work of lifting gravel from the wet pit and dumping it into the dump-wagons waiting to carry it to the concrete-mixer was expedited.

One of the excavators worked on each side of the embankment, manipulating buckets that held about a cart load each. The arrangement also proved very satisfactory in clearing out the stumps that covered the flat lands through which the work had to progress.

Even the sawed-off trees themselves helped in the building operations. They were cut close to the ground, permitting the drag-lines to run over them, thus bringing them finally into the gravel pit where they were extracted by the excavating shovels. The makeshift excavator was proved to be an economic success.

The improvised "drag-line" excavator made from the "stiff-legs" of a steel derrick was used successfully in the Miami Conservancy District, where sixty-five thousand cubic yards of embankment were built with it

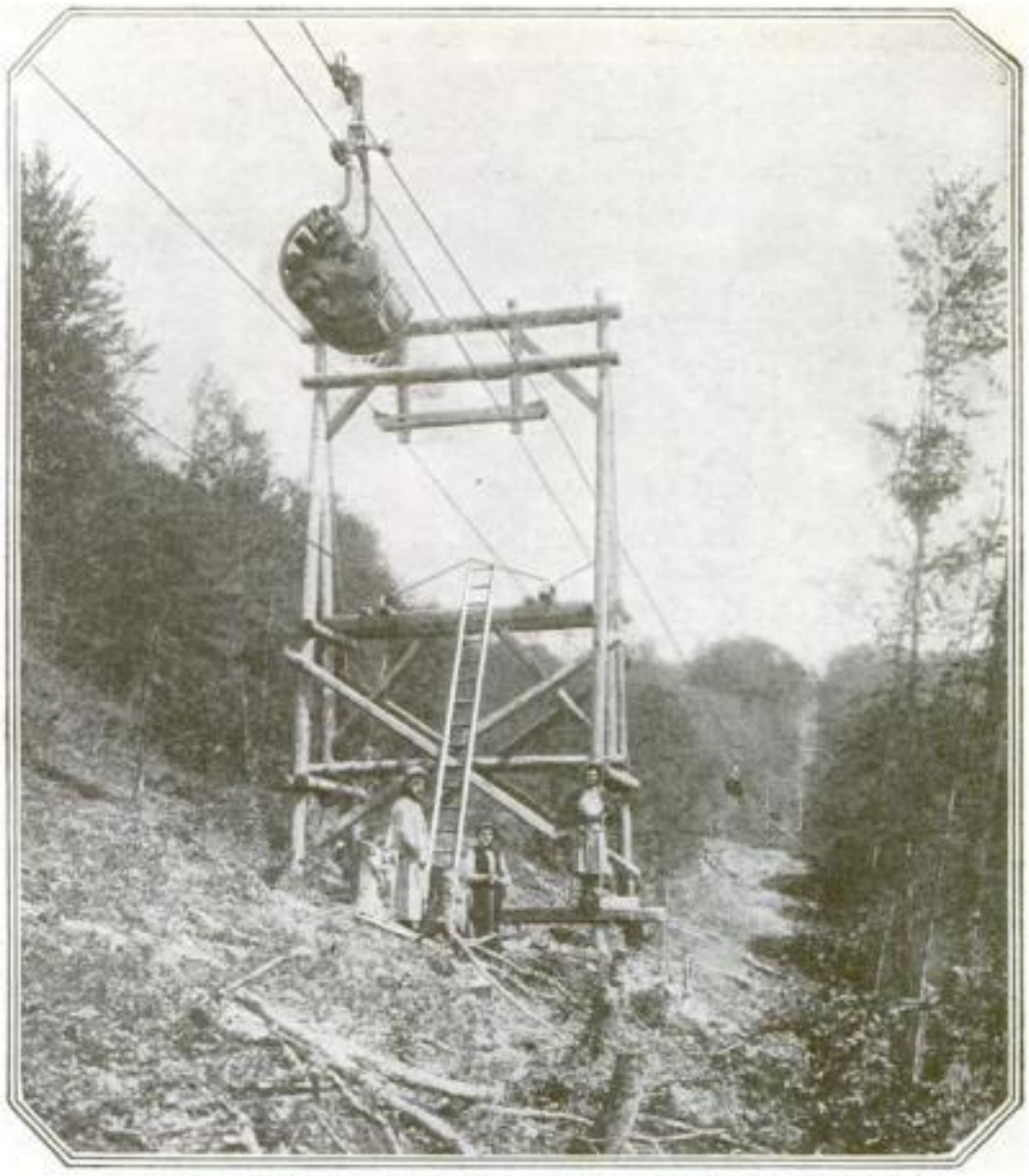
Carry Your Tools in a Suit-Case

He looks like a traveling salesman ready to start on a trip, but he is really a traveling draftsman

"A TRAVELING salesman." That's how you usually dub the man who carries a queer-shaped suit-case. But you may be wrong. The draftsman, for instance, now carries a queer-shaped suit-case, and in it he keeps his tools. The suit-case was the invention of a Milwaukee engineer.

The cover of the suit-case has two pockets in it. One pocket holds a tool case and the other is used for triangles and curves. Above these pockets leather straps sectioned off hold small articles.

Open the lid of the draftsman's suit-case and you will find within books, a drawing board, and a bottle of ink

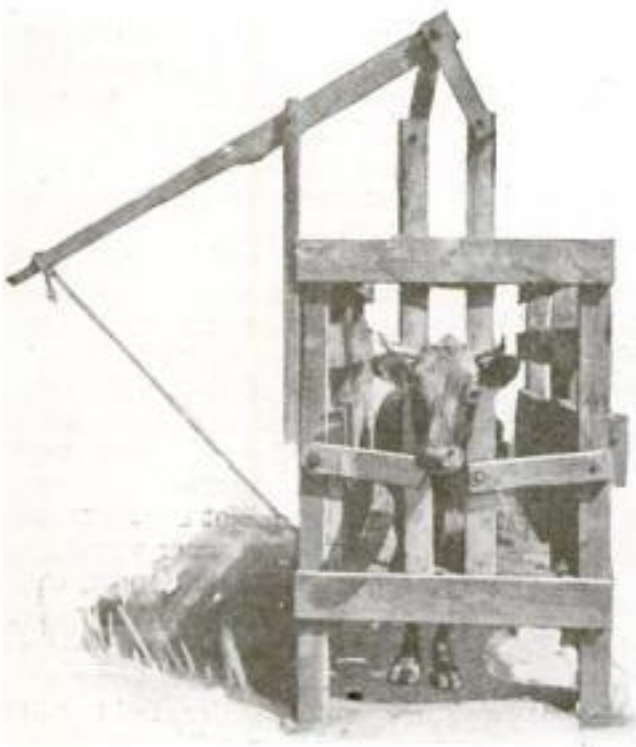


In timber regions that lack the usual transportation facilities, aerial cable-roads are used to reach water-ways or railroads

Cattle Are Not Wearing Horns This Season

"HORNS off," is the new fashion for cattle. This is because horned cattle use their advantage over those without horns: they appropriate feed, and terrorize their defenseless companions. They are also a source of danger to attendants who feed them. The accompanying pictures show a strong chute for confining the animals while they are being shorn of their dangerous horns.

One is driven into the small pen and when it inserts its head in the stanchion, the lever is pulled down. A rope is fastened around the animal's neck and looped around the muzzle so that the head can be turned to one side while the horn on the opposite side is removed. The operation is then reversed to remove the other horn. Tar is smeared over the wounds to prevent infection. Bossie is then liberated, to return to her eight-hour-day-job of chewing her cud. Dehorning clippers are used to remove the bayonets of young cattle, while a saw is employed for mature cattle whose horns are more tough and brittle, and hence liable to splinter and result in wounds.



Her head is held between two stanchions that are moved by a lever handle

Bossie's horns will soon be gone—sawed off. She used them too much

The Aerial Cable Is Used for Transporting Timber

SUSPENDED cable-ways are used in the western mining regions of the United States for conveying ore, supplies and workmen over difficult territory, across streams and valleys. In some European countries, with wild and heavily timbered areas of rugged topography and few roads or other lines of transportation, such cable-roads have made it possible to utilize the rich stores of timber and fire-wood which had previously been inaccessible.

Our picture shows part of a cable-way constructed in one of the heavily wooded mountain districts near the Drina River, which formed, before the war, the boundary line between Bosnia and Servia. Two heavy steel cables are stretched along a series of trestles, following a line as nearly straight as the topography of the country will permit.

On these cables run trolleys by means of which the loads of long timbers or of fire-wood are transported from the loading stations to the banks of the Drina River. The carrying crates, platforms or baskets, relieved of their loads, are carried back to the loading stations over the return cable.

The speed of the carriers is controlled by a thinner cable which is fastened to the carriers and runs over a drum provided with an automatic speed regulator in the form of a fan-wheel. The surplus of the power generated by the pull of the loads in their descent from the mountains is utilized for driving a saw-mill and other machinery at the principal station. Much speed is gained by this method of transportation because distances are covered in a straight line.

Where Wading Is in Order

DROPPING with a realistic shower effect from the branches of a live-oak, which conceal the pipes, the water supply for this wading pool falls first upon a cement "island" housing an aquarium of goldfish, and then cascades into the pool where Los Angeles children play. Pool and fountain were gifts of C. W. Sirch, their designer.

© Kadel & Herbert

Progenitor of the Magazine Rifle

ONE day a thousand years or so ago Chinese troops went against their enemies with a new and terrible weapon in the shape of a repeating crossbow. The weapon which was to supercede clubs, spears, and the single cross-bow, carried eight or ten small arrows in a magazine from which they dropped into the barrel to be discharged.

The News in Six Inches

"BETTER Times" is coming—this is not bad grammar, as you will see later. And it will undoubtedly assist in the Americanization of aliens. "Better Times" is a newspaper—a very small one, but a very good one. It is eight pages thick and each page measures four by six inches. The United Neighborhood Houses publish it every month and charge five cents a copy.

There is great need for a paper like this one in these troublous times of imported Bolshevism. Many aliens came to this country expecting to find the streets paved with gold, and they need the aid of an encouraging newspaper to help overcome their disappointment. The leading article in the first edition is an interview with Lieutenant-Colonel Theodore Roosevelt, in which he urges increased support for the Americanization work that is being done by the neighborhood houses. In spite of its small size this newspaper contains illustrations, including photographs.

He Seems to Have a Grouch

MONKEYS, like women, are not all chatterers. Some of them are quiet creatures who prefer silence to the chatter of their kind. Look at the sad and solemn monkey below. He belongs to the group called saki monkeys, known for their sweet, gentle dispositions and their silent tongues. They have white hair and beards, but are about fifty years behind the times in the way they trim their side-whiskers. And they part their long, crimped hair in the middle.

Smokeless Powder to Light Cigars

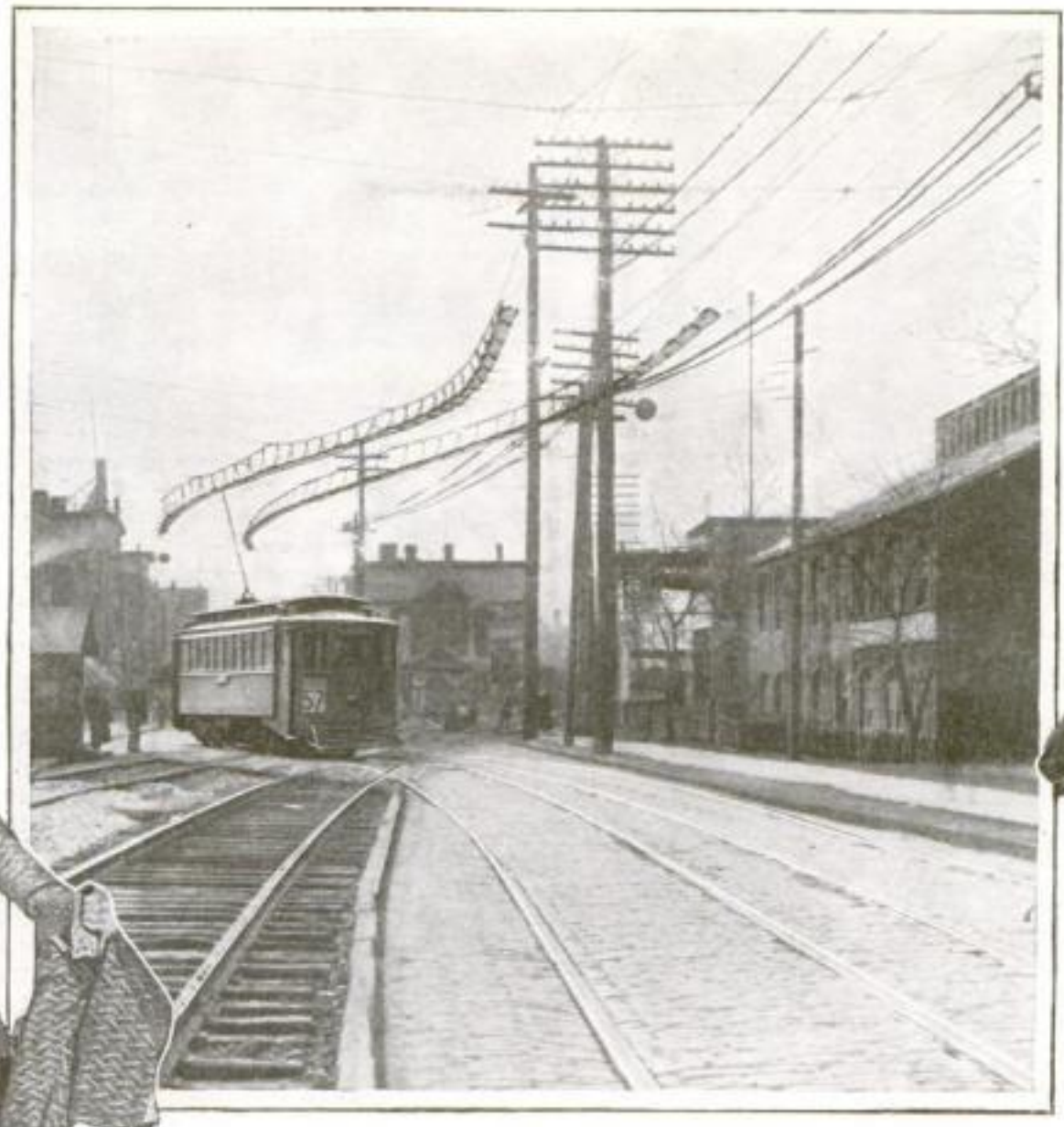
WITH a cigar between his teeth and a smile on his lips, the man above calmly gets a light from a grain of smokeless powder. He knows that he won't blow up, since the powder is not confined. He is using a powder grain that would set off a fourteen-inch gun; yet it doesn't harm him.

Powder will not explode unless it is confined and its gases have no room in which to expand. Take the case of a fire-cracker. You light the fuse, and when the flame hits the powder the firecracker blows into bits. Yet suppose the fuse is faulty and the cracker won't go off. If you break it open, pour out the powder, and set a match to the powder, it will flame up in silence—no damage done. It is probable, however, that a smokeless powder light will never be very popular with smokers. Few men could smile with the careless unconcern of the man in the picture while handling a tempermental high explosive in this informal manner.

The Night-Shirt of an English King

"OFF with his head!" When the court pronounced this sentence on Charles I of England there might have been reasons other than treason. For instance, the judges might have seen him in his night-shirt. It seems to have been almost criminally unbeautiful.

Charles' night-shirt and his night-cap which are here shown were sold recently at Rushbrooke Hall, England, where they were so long preserved.



He's Motoring on Roller-Skates

YOU press the button and then start to roll — that's how you operate the new electric roller-skates. But the chief disadvantage is that all you do is roll—you can't really skate. For the volt accumulator that gives the skates their power is located between them and fastened tightly to them.

Before you turn on the power you regulate a speed switch located on a small disk you carry in your hand.

The Runaway Trolley-Pole Is Caught and Held

BANG! Bang! The trolley car bumps across the railroad tracks and the pole slips off the overhead wire.

The lights go out, the car stops, and a locomotive whistle sounds in the distance. What a fine setting for a smash-up!

However, a new pole guard, shown in the picture above, makes it impossible for power to give out even if the pole slips off the wire. This guard is a trough of woven-wire suspended over the trolley wire. Should the pole jump off, it will simply hit against the trough, which continues to supply power. The car will proceed on its way out of danger where the pole can be readjusted.

The "Scooter" Likes Shoals

"LOOK out there—you'll be on bottom!" The old river-man might have saved his breath, for the boat to which he shouted the warning slid over the shoal with never a bump, and at a high speed. It was Glenn H. Curtiss's new boat, *Scooter*, driven by an airplane motor and propeller.

"Hot Dogs" Kept Hot

NEVER again need the starving ball fan keep one eye on the game and cast the other despairingly in the direction of the frankfurter—better known as the "hot dog"—stand. The Stevens fireless frankfurter cooker will bring "hot dogs, red hot," to the bleachers for the convenience of the fans.

Brand Your Name on Your Umbrella

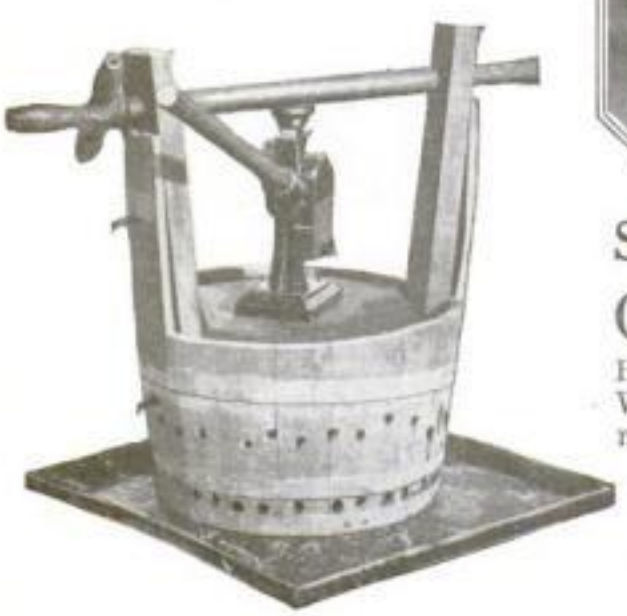
UMBRELLAS are the favorite prey of petty thieves. Even people who would shudder if their honesty were doubted, will borrow and keep umbrellas without a moral tremor. Perhaps the reason is that most umbrellas lack individuality and might be anybody's property. Sympathizing with umbrella losers, James Gilroy, of New Jersey, patented an undetachable umbrella ring on which is blazoned in large letters the owner's name.

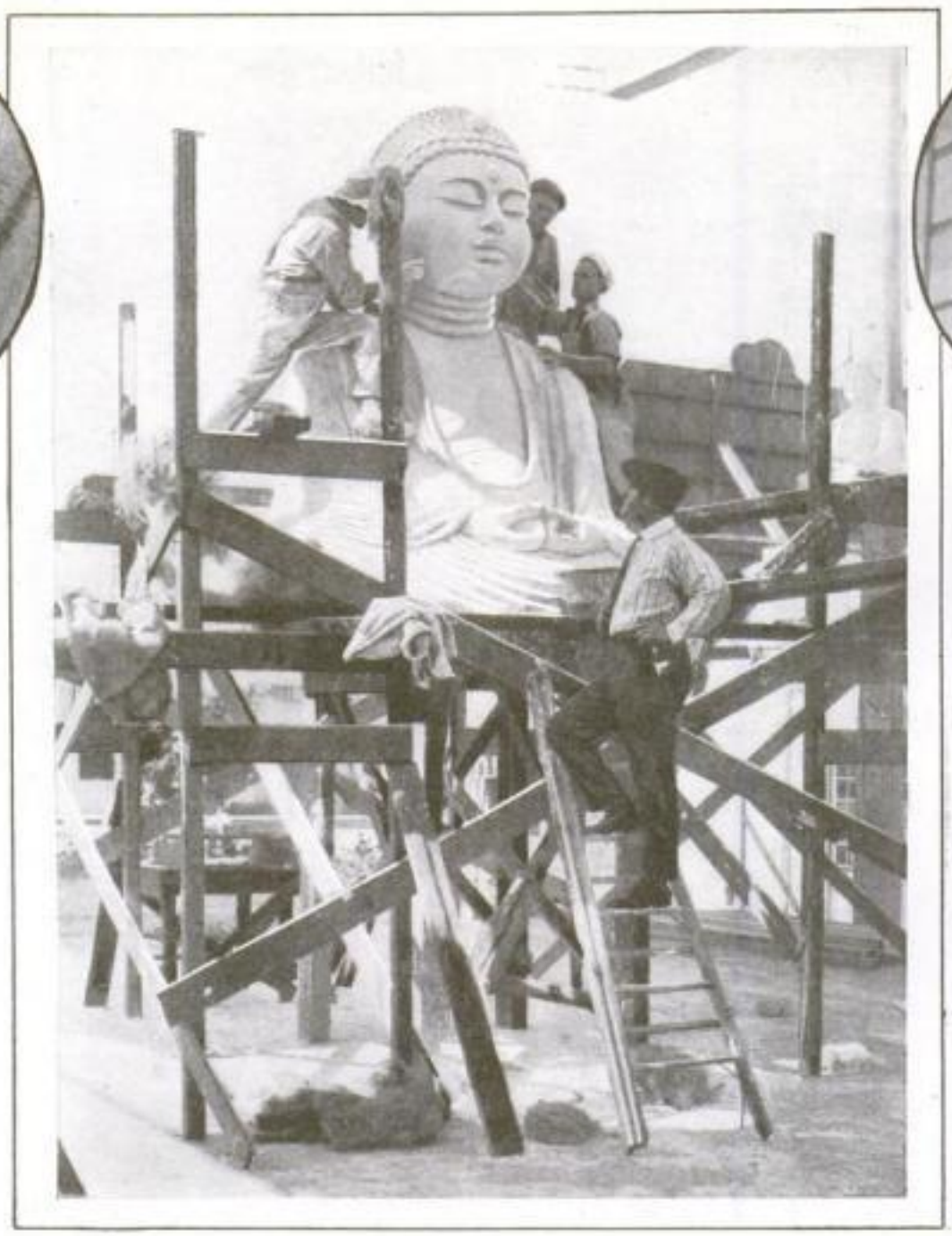
This ring fits over the rib tips and keeps them in place, thus serving a two-fold purpose. It has overlapping ends which slide one over the other, so it can be spread to slip on and off the rib tips.

A Cider-Mill Made from an Automcbile Jack

THERE'S nothing illegal about a private cider-mill, and you will find it easy to make. All you need is an old wash-tub, a jack, and some boards.

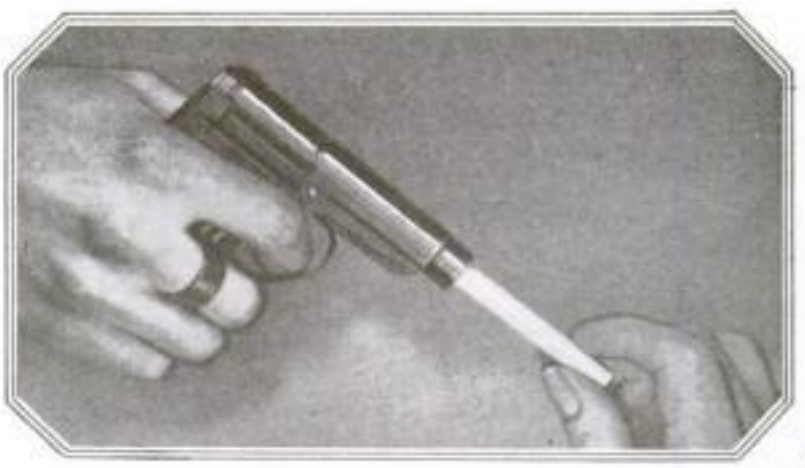
Make a small cover for the tub and erect a frame over it. Fill the tub with apples, put on the lid, then insert the jack between the lid and the frame, and start jacking. The apples are squashed and the juice runs out of the tub.





They Are Making a Buddha for Motion Pictures

WHEN preparations were being made recently at Universal City for the motion picture production of "The Breath of the Gods," in which the Japanese actress, Tsuro Aoki, was to be starred, a huge Buddha, such as those found in temples of Japan, was constructed under the supervision of a noted Japanese artist, C. S. Ito.



Shooting Cigarettes from a Gun

GOT a cigarette? Don't ask an Englishman that question for he may pull a gun on you. He will aim it at your head and pull the trigger! When you open your eyes and find that you're not dead, you will see sticking out of the muzzle of the gun the very cigarette you asked for. With a shaking hand you take it.

This toy gun was meant originally for use on cigarette robbers who always borrow their smokes.

When There Were No Lights o' London

IN olden times when London streets were dark it was customary for "strong-arm" men to act as paid escorts for people out late. With flaming torches they led the way through the streets, and upon arriving at the house of the person they were guiding through the dark, extinguished their torches under an iron hood attached to the tall gate.

In front of many of these old London mansions can still be seen the "link-men's" extinguisher, the worthies who lighted the way being called "link-men." In the picture one is shown at the gate of an old London house where it has been since Shakespeare's day.

An Entomological Crown Uneasy lies the Head—

THE crown the German ex-Kaiser wore upon great holidays looked like the one below, which is studded with bugs instead of jewels. It was made by a disillusioned German. He traveled far and wide gathering bugs for it.

Red bugs represent the rubies of the original crown, while white bugs serve for pearls.

"Home" Is a Box-Car

STRANGE sights follow in the wake of great wars. Whole communities are disrupted, families scattered, homes destroyed, and all leave their curious mark upon the lands engaged in conflict. Hordes of homeless people must find a spot sheltered as best it can be, a spot which they can individually call "home." But a box-car is an extraordinary place for domestic bliss!

Several members of the "Iron Division" compelled to leave the Baltic sought refuge in a box-car. They adapted it with ingenuity to the condition of habitability, even making in it a place for the family pet, the dog. Here they wait to return to Germany.

Make Your Concrete Blocks

INSTEAD of waiting for the expensive load of bricks delayed by the great shortage in building material, get one of these machines and make a substitute for the bricks.

The concrete is poured into a mold which has a movable bottom. The workman operates a foot lever which raises up the concrete when it has set sufficiently to be removed. The block is then easily lifted off by hand. An industrious man can turn out four hundred blocks in a day without any great expenditure of energy.

The "Ophir" Comes Home

THE U. S. S. *Ophir*, a transport that was sunk in Gibraltar Bay during the war, was raised by the United States navy and sent home under her own steam. An explosion followed by fire had caused the vessel to sink. With practically no repairs made, the badly damaged ship started bravely for home with a crew of six officers and sixty-eight men.

Her decks were uncovered and full of shell-holes; only three boilers were working. When two days out from the Azores, the boilers broke down and the *Ophir* had to be towed into port. When the boilers were mended she started out again. But she ran into a storm and drifted around helplessly, miles out of her course. Finally the *Ophir* limped safely into Norfolk.

Horses Motor to Races in Their Own Cars

NO longer will race-horses which are worth $10,000 or $15,000 have to be trusted to the railroads for transportation. These valuable horses do not like shrieking whistles and grinding brakes of the trains.

Racing steeds are nervous animals, so the motor-trucks that have recently been devised to convey them, offer great advantages over railway trains for transporting the horses.

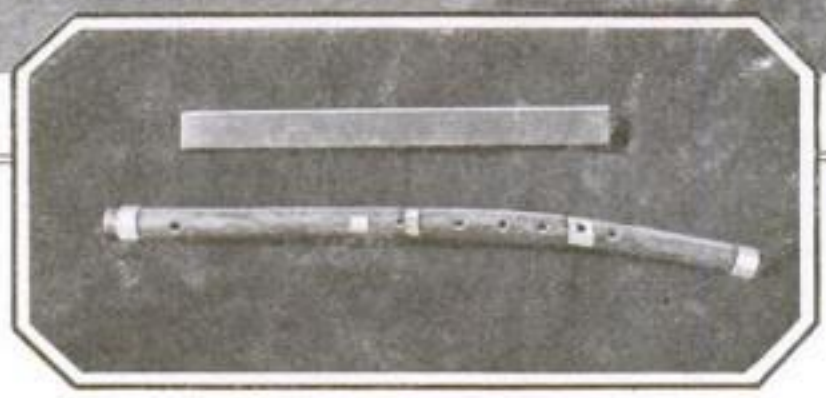
The modern motor box-car for horses is equipped with padded stalls and is electrically lighted. Four stable lads can travel in the same car. The horses can be more quickly loaded into their own compartments, and they can be more rapidly transported to their destination, since the usual railroad practice of shunting cars is avoided.

With this improved travel, the horses should be in their best condition when they arrive at the race-course. The nerves of the spirited animals are protected from the jar and shock of railroad travel, and the horses are not subjected to the nerve-racking process of shunting in the freight-yards.

Dictating Letters in an Airplane by Telephone

THE busy business man and his stenographer can turn out a number of letters in the course of an airplane trip from New York to Washington. The "click! click!" of the little typewriter is completely lost in the roar of the propeller, and the words that are dictated would also be drowned if special telephone connections between the two persons in the closed compartment were not made.

The helmet worn by each of the passengers cuts out enough of the engine's noise to permit the easy dictation of letters. Both compartments are electrically warmed.



Music from a Wild Carrot Is Like That of a Flute

AN actual music-making flute eighteen inches long by three-quarters of an inch in diameter has been made from a hollow wild carrot weed. The music which the wind whistled through the weeds, and which became instilled in them has been brought to life in the flute by the skill of the workman. He kept at his job until all the tones of the instrument were accurate.

The fragile ends of the flute were strengthened with abhesive plaster. One end was tightly stopped with a cork and sealed with paraffin. The flute has a remarkably sweet tone.

Where Work Is a Party

THE flax combers of Portugal are a happy people. It is the custom on the Iberian peninsula to make of work a gala function. Garbed in their best, adorned with bright gold ornaments, their garments an array of color with gay embroidery, men and women meet to carry on the ordinary daily vocations. In Portugal, that of winding flax is usually given over to the women. The flax combers in the illustration are of the town of Vienna do Castello in northern Portugal.

Churning Is Easy Work!

THIS little lady should worry if her mother tells her to run along and churn the butter. She takes her electric churn into the parlor, hitches it to an electric light socket, turns on the switch, and the churn goes to work.

The machinery of the electric churn is made of spring steel which not only gives it extra strength, but great rust resisting power as well. The movement of the dash rod and paddle is that which has been used for many years in the hand-power churn.

He Wears a Hand Shield

MEN who do acetylene welding often suffer from burned hands—the heat from the flame is so very intense. But a new hand shield has just been invented by Charles S. McCreery, of De Soto, Missouri. It consists of a curved plate of non-heating material and two wire loops through which the welder thrusts his middle finger. The shield is not large but it gives the hand sufficient room to move in, and there is plenty of air space. The non-conducting shield is made to resist the most intense heat.

Sweeping Dark Corners by the Light of a Flash-Lamp

"JUST look at the dust here in these corners of the room—why, you didn't sweep these corners!" exclaimed an angry housewife when she saw how unfaithfully her dutiful spouse had performed the task set for him.

"Well, I'm not supposed to sweep where it's so dark, I can't see what I am doing!" he retorted.

Then the lady had an idea. She got the electric flash-lamp and fastened it to the broom with two rubber bands. With this as a torch, no matter how dark the room, the corners would be well lighted where the broom reached them. At least there would be no excuse for not having them well cleaned. The lamp is useful for janitors who work in dark basements, or housemaids who must carefully sweep dark halls.

The House of Hearts Has Heart-Shaped Furniture

"HOME, Sweet Home" signs fade into insignificance before the home-loving outburst of Mrs. E. C. Calder who lives in Pasadena, California. Tables, chairs, doormats, in fact all the furnishings in her house are heart-shaped.

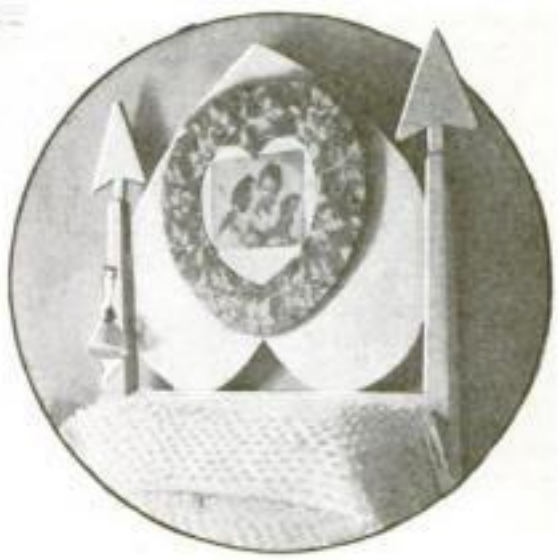
Her bed, for instance, has a heart-shaped headboard, supported on both sides by bedposts carved to represent cupid's arrows. The heart-shaped headboard is decorated with a heart-shaped picture frame in which two loving angels embrace each other.

Mrs. Calder calls her house "The Pericardium" which, physiologically speaking, means the membrane that encloses the heart and the roots of the great blood vessels. Perhaps we do Mrs. Calder an injustice when we suspect her of an over-attack of sentiment. Her husband is a physician and she may be simply trying to advertise.

© Keystone View Co.

Meat for a Turkish Market

CONSTANTINOPLE, the melting pot where East meets West, offers many strange sights to the traveler. "What are in those cages that the horse is carrying through the streets?" Each wire cage holds a hindquarter of beef. If the wire mesh were not so coarse it might keep out the swarming flies. But Constantinople is a city of ancient customs and careless sanitation.



Dark Patch, Hunter of Elephants

DARK Patch is a dog of fighting blood. His master was attracted by his pugnacity and his intelligence, and purchased Patch when on a trip to London. When only eight months old Patch went to the Congo with his master hunting elephants and buffalo.

Eighteen elephants were shot on the first trip Patch made. Returning to Antwerp from Boma, west coast of Africa, Patch became seasick, but when his master decided to take him on another expedition, Patch was overjoyed and displayed no aversion to boarding the steamer again. A third time he went and after nine months in the most desolate part of the Belgium Congo, returned with his master who brought with him thirty-eight tusks.

Magnifying the Strains of a 'Cello

CONNECT a metal tube with the 'cello and then with a large metal horn, and the faintest sounds emitted by the bow will be better heard by the audience. The principle is that employed in "talking machines." The sound-waves passing through the column of air are intensified in the horn and are projected into the room as though emanating from the horn instead of from the 'cello.

One is familiar with the sounds of a vibrating column of air in the pipes of a pipe-organ, or in a cornet. The principle is identical with that employed here, except that the 'cello's tones are made more audible by the curved shape of the horn. In an orchestra the deep notes of this instrument are intensified by its horn.

© Keystone View Co.

He Makes the Weather Pay

The industrial meteorologist advises farmers and aviators

By Lee McCrae

Dr. Carpenter's balloon starting on a voyage of scientific discovery. Air lanes and landing places for aviators are determined on these air trips

MANY a man lives "with his head in the clouds," but none more literally than does Dr. Ford A. Carpenter, of Los Angeles. Yet he is a practical scientist and has been appointed industrial meteorologist of the Los Angeles Chamber of Commerce.

"'Free air' signs here in California are supplemented with free air information," Dr. Carpenter laughed, referring to his work. "I am the advisor of aviators, orchardists, engineers, farmers, surveyors, doctors, and manufacturers, and I am about the most industrious industrial manager you ever saw. I have recently charted the wind currents of southern California, established fourteen safe landing-places for aircraft, given a series of twenty-four lectures on climatology and kindred themes, located soap factories, a rubber plant, town sites, sanatoriums, and——"

"Buzz!" interrupted the telephone at his elbow. A moment later, in answer to a question, he was saying: "No, don't go up today. Your pictures would not be good taken under present conditions. Wait until we have had a rain. Call me after that and I will fix your elevation. Glad to tell you! So long!"

Then he went on: "That is a small sample of the work. I saved that young man a lot of expense trying to photograph Pasadena from the sky. It would have been time, trouble and money thrown away to go up today."

"Then you are a Weather Bureau *plus*."

"Exactly. Plus years of first-hand experimentation. I spent thirty-one years in Government Bureaus from Portland to San Diego, and on that experience I have built. Aviation now demands wind charts and definite air lanes. I am the first observer who has made systematic meteorological studies while in actual flight, and so can instruct flyers to go along at a certain altitude to—say San Francisco, for instance—and return by another altitude in order to have the winds in their favor, and avoid mishaps and possibly death. Recently we spent the night in a balloon noting the movements of night air-currents."

Few people know of the powerful influences of air-currents upon agriculture. Dr. Carpenter displayed photographs of Los Angeles and its suburbs, and told of the climatic survey made of the big Vanderlip ranch which enabled its managers to plant it scientifically.

"I spent last night in an orchard," he added, "rolling in my blanket for three hours' sleep on the ground so that I could give the owner of the orchard data concerning early morning conditions in his grove."

"And today you were lecturing at the university on medical climatology."

"Oh, yes, but the trips into the country and up into the sky are so much recreation. The diversity of the work makes it possible for me to go three days and nights at a time without removing my clothes and with only a few hours' sleep. The very contact with the earth and the upper air keeps one healthy.

"In fact, medical climatology, linked up with aeronautics, is our next advance along curative lines. Instead of doctors ordering tubercular patients to distant sections, breaking up homes and causing untold misery and expense, they will simply send a bunch of them up in an airship to float at a certain altitude for so many hours a day. The effect will be marvelous. Our army aviators learned that their headaches vanished in their flights, that they could go up with a bad cold and come back without it. It will be my work and that of other practical meteorologists to determine the best strata for these patients. This must be done locally, since different sections are altogether different atmospherically."

Of aviation, Dr. Carpenter declared, "The airship—not the plane—with engine and all within the envelope, using the non-explosive, non-inflammable gas, will be safer and more comfortable than the present railway coach, so it will be a joyful as well as a beneficial trip into the blue.

"Did you know that Kipling is the prophet of aviation? Along in the '90's he originated the term 'air lanes' and all but visualized present aeronautics. The traffic is ready, waiting; we have only to build the ships and map out our ocean to ocean highways in air as on land. That is my chief job now."

Amid all his daily duties, with their interruptions, this citizen of the air has found time to write fifteen books on scientific themes, to lecture in biological universities and clubs, to arrange the gold medal exhibit in meteorology at the San Francisco Exposition, and to qualify as an international pilot of aircraft, ready for the license issued only to the favored few, which permits him to fly over all national boundaries.

Just after a thirteen-hour night balloon trip to gather data on air-currents, valuable to farmers as well as to aviators. Dr. Carpenter is at the extreme right in the picture

Grandpop Crandall—Inventor of Toys

He is probably the greatest technician of his kind in America

By Herbert Asbury

ALMOST any afternoon in the summer-time, if you happen to be walking on a certain street in Brooklyn, you will see a veritable flock of children—boys and girls from four to eleven years old—sitting on a stoop, waiting and watching. And every little boy and little girl will have tucked under an arm the remnants of a toy—a engine with a loose wheel, a go-cart that won't go, or a doll with a smashed head. Every now and then one of them will get up and slide down to the sidewalk, to look anxiously down the street.

And then, about half past four o'clock—almost always exactly at half-past four—an old man—a very old man, in fact, because he is eighty-eight years old, and he wears side-burns like those that adorned Horace Greeley—an old man turns the corner. Immediately there is a shout of "Grandpop!" and the last fifty yards of the old man's journey is made with considerable difficulty, since there are boys and girls hanging to both hands, jerking at his coat-tails, getting entangled with his legs, and literally climbing all over him. And each one wants something:

"Grandpop, fix my doll!"

"Grandpop, lookit my engine! It won't run!"

"Grandpop, put a new wheel on my wagon?"

And so on, *ad infinitum*.

©Press Illustrating Company

As a boy, Jesse Armour Crandall was never so happy as when he was working in an odd corner of his father's toy factory in Brooklyn. As a young man he went to Ohio and taught toy-making to the inmates of one of the prisons. Later he conducted his own business in Brooklyn, where he still lives

A Wizard With Toys

Finally the old man reaches the stoop of his house and sits down. Then he begins taking things from his pockets—bits of wire and pieces of string, and a little bottle of glue, and knives and small punches and odds and ends—and begins to fix things. He glues a head on a doll; he performs amazing surgical operations that restore absolutely broken china arms and legs; he does wonders with a broken fire-engine, and makes it rush furiously about on the sidewalk, hurrying to an imaginary fire. Then he takes a jack-knife and carves a boat or a man or something from a block of wood. And all the time the children watch him in rapt enchantment They regard him as nothing less than a wizard

"Grandpop can fix anything!" they say.

And Grandpop certainly can fix any toy that the ingenious mind of man ever contrived. He ought to be able to do that, because Grandpop is Jesse Armour Crandall, who has been inventing toys for seventy-five years. Even as you read this, your baby is perhaps staggering about the room safely encased in a baby-walker that Mr. Crandall invented, and your young son may be lassoing bronchos from the back of a plunging hobby-horse that also originated in the fertile brain of this toy-inventor.

Mr. Crandall is undoubtedly the oldest toy-maker in the United States. He has taken out patents on more than one hundred and fifty inventions. Children all over the world owe him gratitude for their hobby-horses and shoofly horses, for many types of fire-engines and wagons, for sand-molding machines, for picture blocks that fit one within another, for go-carts, and for all sorts of wonderful things.

Children of every nation under the shining sun, almost, have played with toys invented by Mr. Crandall, and children of royalty and of high officials of England and the United States have had fun with them, too. When the old toy-maker was a young toy-maker he made a giant hobby-horse, almost as big as a live pony, and sent it as a gift to the royal youngster who afterward became King Edward VII. It was the first hobby-horse in England, and Queen Victoria wrote to Mr. Crandall that it was a very difficult matter to induce the young Prince to stay off it long enough to eat and sleep and do his lessons. Mr. Crandall has made toys, too, for the children of American presidents. When Grover Cleveland was in the White House the toy-maker abandoned his toys long enough to invent and manufacture an invalid's chair that gave the President's little daughter the first comfort she had had in many months.

Mr. Crandall began making toys when he was three years old. He wanted a sort of revolving wheel to play with and nobody had time to make him one. So he got a big knife and a piece of plank, and by dint of extreme labor and at the cost of several severe cuts—he bears to this day the scar on his forefinger where the knife slipped and almost amputated the finger—he turned out a revolving wheel that would really revolve. After that he made every toy he wanted, and invented a great many when he was a boy, that later, when he became old enough to realize their value, he patented. This fisrt toy was made in Wesley, Mass., where the Crandall family moved from Maine.

Hundreds of Inventions

The young inventor went to New York with his father when he was seven years old. There he worked in his father's wagon factory, boring holes in hubs. This was rather hard, slow and tedious work, so young Crandall invented a machine to bore the holes, and with this machine he could thereafter bore as many holes as he liked, depending upon the ratchets on the machine, instead of boring one at a time with a brace and bit. This same ingenuity and skill he displayed later in developing hundreds of inventions, for he has invented many more machines and toys and things that he never patented. Grandpop's life has been just about one toy after another.

Why Not Make Your Automobile Do It?

The engine is ready and willing to work for you

This man once saw a doctor use a headlight in removing tonsils, so he used a funnel with a lamp, leaving his hands free to work on the automobile engine, at night

He decided it would be a civil thing to do, to hand his guest a moist cigar from the door pocket. The door humidor keeps fresh a few choice smokes for occasions

An emery wheel attached to the headlight steadying bar and revolved by the crankshaft does away with the tramp scissors-grinder. Any blade may be sharpened by the motorist using this method

Making a car raise itself does not require a magician if you have an engine-driven tire-pump and a pneumatic jack. No lifting, groaning or cursing results. The jack is on duty but is not shown in the picture

He spirited away his wife's sewing-machine motor and ground his car's valves with it. The grinding speed was regulated by the foot-pedal as the speed of a sewing machine is regulated. Meanwhile the family sewing waited to be done

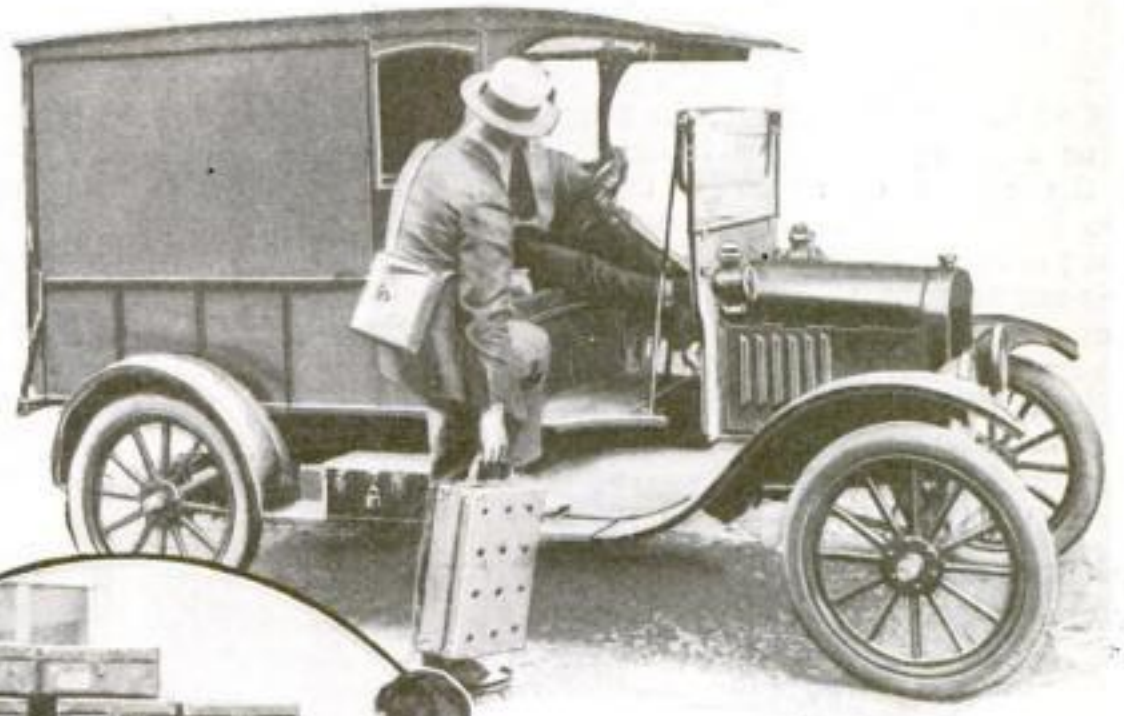
(*Left*) Why not let the engine freeze the ice-cream? Attach the engine crankshaft to the handle of the freezer by a flexible shaft, with the car in low gear. You may save your energy while the car cheerfully does the work

(*Right*) A polishing cloth is fastened to the revolving shaft of the sewing-machine motor and the car is polished in very short order

What Becomes of Telephone Nickels

After you drop them in the slot their adventures are varied and interesting

Down into a dark, sealed chamber fall the nickels. When they have about given up hope of rescue, along comes a collector who removes the filled chamber and leaves an empty one instead



When the collector has a dozen filled coin-boxes in his suit-case he goes to the place where a truck awaits him. He leaves his loaded suit-case in the truck and takes with him an empty one

The original group of nickels is now surrounded by millions of other nickels in the same predicament. In their dark chambers they are locked up in suit-cases and placed in a safe for the night, all secure from rescue

Empty coin-boxes are brought here to be sealed. First they are locked. Then they are put into the sealing-machine, fastened with a strong lock and seal

Suddenly the gates are opened and the nickels tumble out. They are shoved down a counting-machine, land in a bag, and in the process are automatically counted

Preserving Food Forever with Gas

How a woman discovered a way of asphyxiating the bacteria that cause decay and thus gave the world a marvelous process for keeping meat, milk, fruit, and all other food for centuries

By Waldemar Kaempffert

IT was the great Pasteur who taught us that food decays because of the action of invisible, destructive bacteria. Kill the bacteria and you prevent food from rotting. But how are they to be killed, or at least prevented from propagating? There are bacteria everywhere—billions and billions of them in the freshest lungful of air or mouthful of food—and they reproduce their own species with astonishing rapidity by the simple process of self-division. How is this growth to be checked? How are bacteria to be killed? When you answer these questions correctly, you explain how food may be kept forever; you show how the high cost of living may be reduced; you abolish the criminal anomaly of fruit rotting on the ground while it brings a dollar a bushel in a city fifty miles away.

Boiling Doesn't Always Kill Bacteria in Food

Pasteur, of course, suggested ways of killing bacteria. That would almost follow from his mere discovery of the real cause of putrefaction. He decided that bacteria could be most effectively killed off by heat. That is the whole secret of the process of pasteurization. We know now why canners and housewives boil fruits and vegetables that are to be preserved.

Not much was known about bacteria in Pasteur's day—very little, for instance, about the tenacity with which they cling to life. It was discovered long after Pasteur made his revolutionary announcement that heat does not always kill. It simply shocks—arrests development. The spore of the deadly anthrax germ still lives after five hours of persistent boiling. Many forms of bacteria resist the much lower heat applied in Pasteurization Moreover, the application of heat inevitably produces chemical and physiological changes in food. Everyone knows what happens to an egg when it is boiled or to a steak when it is broiled or to cheese when it is melted.

Bacteria need warmth, moisture, and oxygen if they are to propagate. Cold storage preserves eggs, meats, and other foods because the destructive bacteria are deprived of warmth. But they are not killed. As soon as the milk or the meats are taken out of a refrigerator they begin to putrefy. That is explained by the fact that foods cannot be refrigerated suddenly through and through. The outer surface is chilled first. Self-preservation is the first law of bacteria, as well as of human beings. If they can't preserve themselves, they will at least try to preserve the species. Bacteria spore at once; in other words, they lay "eggs." When a beef carcass is taken out of an icebox, the eggs develop as soon as they feel the first breath of warmth. Remember, they are numbered, not by millions, but by trillions and trillions.

On the shelves are food products that range from fruit juices to solid vegetables, such as corn on the cob and nuts. They were placed in their containers years ago; and yet, they are as fresh as the day when they were first preserved by the new process

WHY the well known properties of carbon dioxide have never before been applied in preserving fruits, vegetables, meats, butter, and milk must remain an inexplicable mystery. It has remained for a woman to reveal the startling possibilities of the gas as a food preservative.

Mrs. Franks, the discoverer of the process here described, has found it necessary to interpret micro-organic life in a way that will probably be objected to by most bacteriologists. At all events, the theory that she has evolved seems to be proved with startling conclusiveness by results.—EDITOR.

Suffocating Bacteria to Preserve Food

Between the molecules of every liquid is free oxygen. Whether a living thing be a whale, a man, or a bacillus, it must breathe oxygen. A man can be killed by depriving him of his oxygen—not necessarily all of it, but enough of it. If it were possible to prevent a micro-organism from breathing oxygen, that micro-organism would die. It is true that modern bacteriologists draw a distinction between bacteria that do and do not live in air. All live in air. If some apparently do not, it is because their demand for oxygen is very minute.

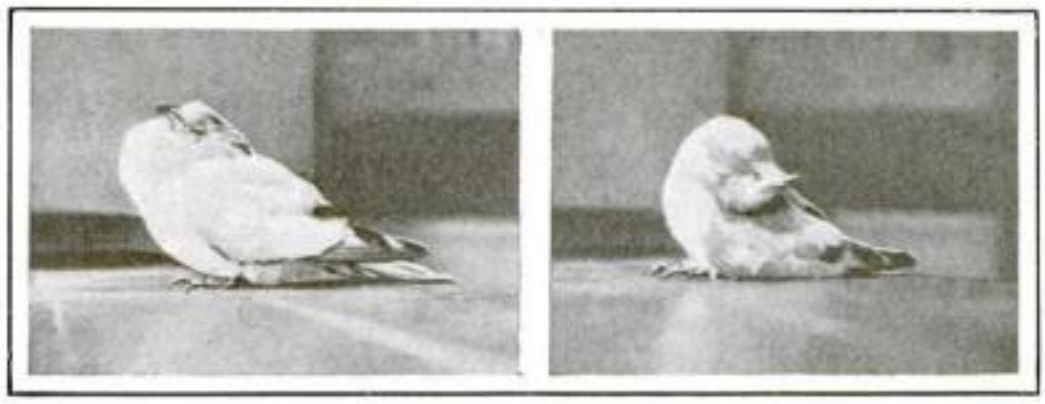
It may seem ridiculous to think of suffocating a living thing so small that you cannot see it. Yet that is the underlying principle of the very remarkable food-preserving process discovered by Mrs. Helen C. M. Franks. She turns on the gas—not figuratively, but literally—and annihilates the bacteria of putrefaction by the trillion.

What gases would kill you if you were to breathe them instead of oxygen? Half a dozen at once occur to you—marsh-gas (so deadly to miners), street-gas, nitrogen, carbon dioxide, carbon monoxide, chlorine. While any deadly gas would undoubtedly kill bacteria if it were substituted for oxygen, the effect on the food in which the bacteria are contained must be considered. The gas must be sufficiently inert—that is, it must not combine chemically with the

food to be preserved and thus destroy its character. Nitrogen is such a gas. Less inert, but admirably adapted for the purpose, is carbonic-acid gas—carbon dioxide.

There are very good reasons why carbon dioxide should asphyxiate food-destroying bacteria. In the first place, it is deadly. Lower a lighted candle into a brewer's vat filled with it and the flame is at once extinguished. Lower a man into the same vat and his flame of life would also be extinguished. But there is another reason.

When you breathe in fresh air (oxygen) you breathe out carbon dioxide. Shut yourself up in a hermetically sealed room and you would be killed by your own carbon dioxide as surely as if you turned on the gas in the room. So it is with a bacillus. It breathes in oxygen; like you, it breathes out carbon dioxide. Unless its supply of oxygen is renewed, it perishes.



Healthy pigeons were infected with scrofula and neuritis and when near death were fed with orange juice, which is rich in the vitamines necessary to support life. The juice had been preserved for eight months by the Franks process. But the pigeons revived, and the experiment proved that in foods preserved by this process the vitamines are not destroyed

Carbon Dioxide Is Fatal When Breathed by Bacteria

In the process of "frankerizing" foods, bacteria are killed by means of carbon dioxide. Assume that there may still be left a minute quantity of oxygen. The bacteria consume it. They substitute for it—what? Carbon dioxide that they exhale. Their death is inevitable.

In carrying out the process a law discovered by the English physicist Boyle is applied. At equal temperatures, Boyle said, two gases will mix perfectly—but only then. First of all, carbon dioxide is introduced into the food-container at the proper temperature. The air that surrounds the food—liquid or solid—is thus properly diluted. Next, the container is exhausted by a vacuum pump. Now comes the final stage—recharging the container with carbon dioxide. Like the first step, the second must be scientifically carried out. Hewlett discovered that if a substance is subjected to a sufficient pressure of carbon dioxide, it will give up its oxygen and absorb an equivalent volume of carbon dioxide. Since the oxygen must be removed, Hewlett's law is applied. The carbon dioxide simply takes the place of the minute quantity of oxygen left, and thus chokes the bacteria to death.

But, it may be argued, if carbon dioxide kills men and bacteria when they breathe it, why should it not also kill when it is eaten in food? It is a favorite trick, in college laboratories, to eat small quantities of solid carbon dioxide snow. Gases act only on the blood that courses through the lungs; carbon dioxide must be breathed in order to kill.

Treated by Mrs. Franks' process, dairy products (milk, butter, and cream) can be transported in ordinary freight-cars without ice. Mrs. Franks' one ambition has been to make dairy products cheaper, and above all to provide infants with pure milk at a price within the purse of the poorest family. Berry juices and pulp, which can be preserved only with much boiling and the aid of sugar, are kept for years after they have been frankerized. Sweet butter, which cannot be kept in cold storage for two weeks, is kept sweet for two years in an atmosphere of carbon dioxide. Milk has been kept for five years. Raw meat has been kept for five years and fish for several months. How long can foods be thus preserved? As long as the atmosphere of carbon dioxide is maintained, and that depends entirely on the character of the container. There is no reason why butter or fruit should not be kept for a century if materials can be found to withstand the corrosion of time.

It was discovered in 1907 that what are called "vitamines" must be present in food if we are to be nourished properly. Once it was supposed that proteins—by which we mean tissue-building substances, carbohydrates (starches and sugars), fats, water, and salts—were all-sufficient in food. Now we know that without vitamines they would do us little good. Professor Casimir Funk coined the name "vitamines." No one has ever seen vitamines. No one knows much about their chemistry. All that scientists do know in a superficial way is that they are vitally necessary.

The Importance of Preserving the Vitamines

Vitamines in food must not be destroyed or removed at any cost. Pasteurization destroys the vitamines because heat must be applied. Think what this means to babies!

An adult in any ordinary community is almost sure to eat enough vitamines, because his diet is mixed. We suffer no injury if we use palatable substitutes for high-priced butter, or if we consume dry milk. But an infant subsists on milk alone for months and must depend on it for the necessary vitamines.

These jars contain eggs, sweet butter, and sliced bacon, which were preserved by means of carbon dioxide, and the replacement of the oxygen. They are perfectly fresh

Tomato pulp is in the first container, squash in the second, and corn on the cob in the third. Tomato pulp is notably difficult to preserve, but this has kept for three years

This tiny monkey burned his fingers, and the hospital doctor is applying a soothing salve

Giving the parrot medicine for his cold at the "Mr. Dooley" bird hospital run by these two women

Treating Patients at "Mr. Dooley's" Hospital for Pets

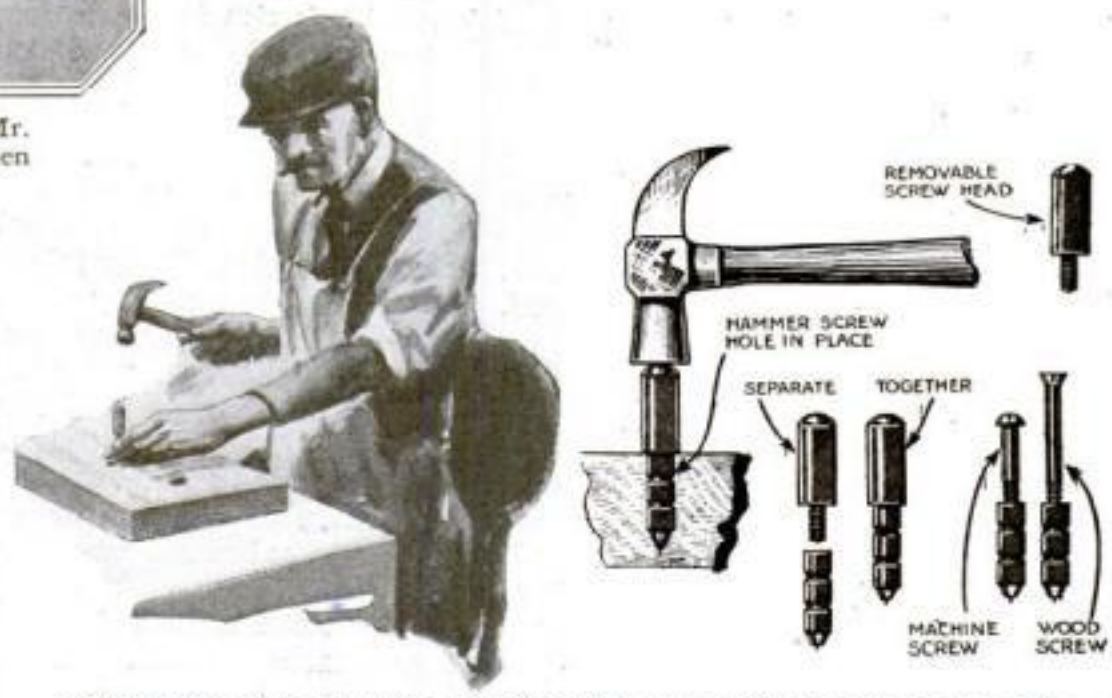
IS your bird sick? Then take him to Mr. Dooley. This "Mr. Dooley" runs one of the best bird and animal hospitals in existence. And who is he? It isn't a he at all, but two women—Miss T. M. Jenkins and Miss A. F. Thompson—who are well skilled in the care of animals, and who do business under the firm name of "Mr. Dooley." Their hospital is a large one and is divided into wards after the fashion of hospitals for human beings. Charity patients receive just as good care there as pampered pets of the rich.

As yet no one has complained of the treatment received, and the food gives perfect satisfaction to a wide variety of patients.

Ready-made Holes Are On the Market Now

HERETOFORE you have had screw holes made to order, but now you can buy them ready made. A pointed brass tube is threaded on the inside to receive the screw. You hammer this tube into the wood securely, and its threaded interior serves as a screw hole. The wood can be used over and over again since the brass screw hole will never grow large through wear.

How do you hammer these tubes into place without flattening the tops? A special steel screw comes with each sized tube, and it is screwed into the tube before hammering is begun. When the tube is flush with the surface of the wood, the steel screw is removed and the regular wood or machine screw may be quickly screwed into place when you are ready for it. This saves wear on the wood.

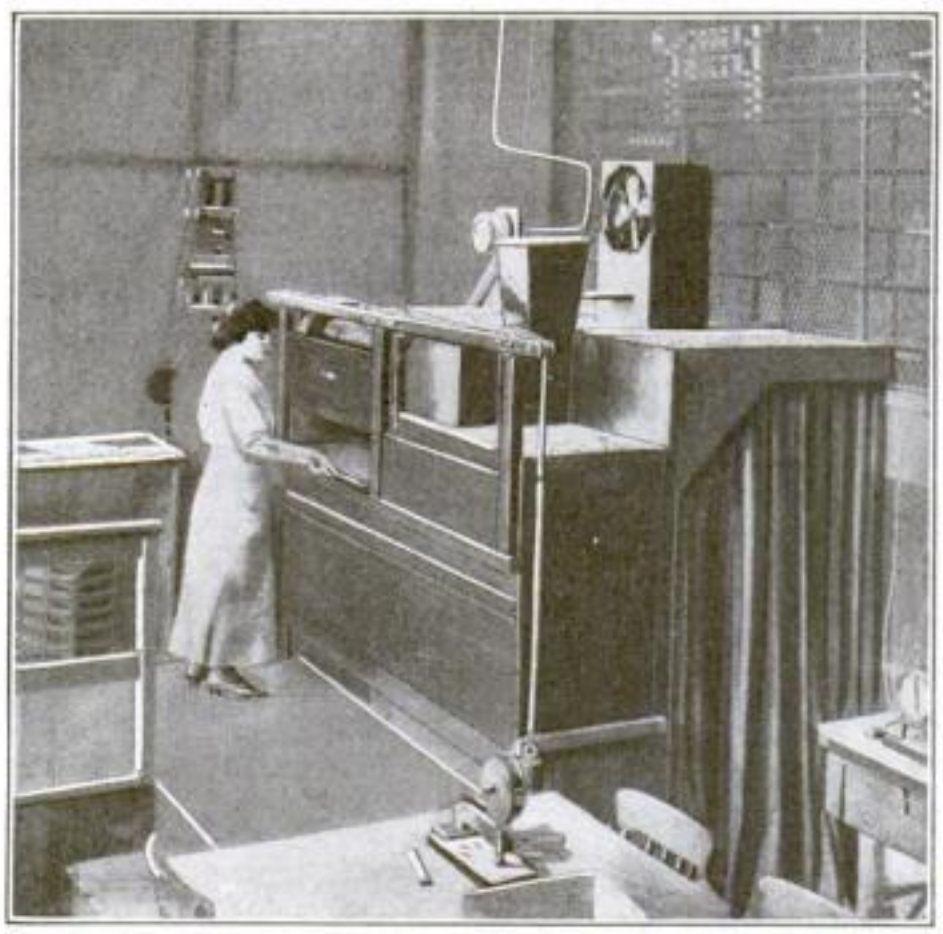


A brass tube that is threaded inside, is hammered into the wood and acts as a screw hole for a wood or machine screw; it will never spread

Using X-Rays to Reveal Flaws in Sheets of Mica

CHIPS of mica, or isin-glass are sent from the mines to be made into sheets that are used for insulation in various electrical devices. In building commutators for direct current generators and motors thin sheets of mica separate the copper parts and prevent short-circuits which would do great damage to the machines. Thousands of dollars are thus saved by a thin piece of this material which has a high resistance to electricity action. But the sheet of mica must be free from the smallest defect, such as bits of metal, or pin holes which would permit the passage of the current.

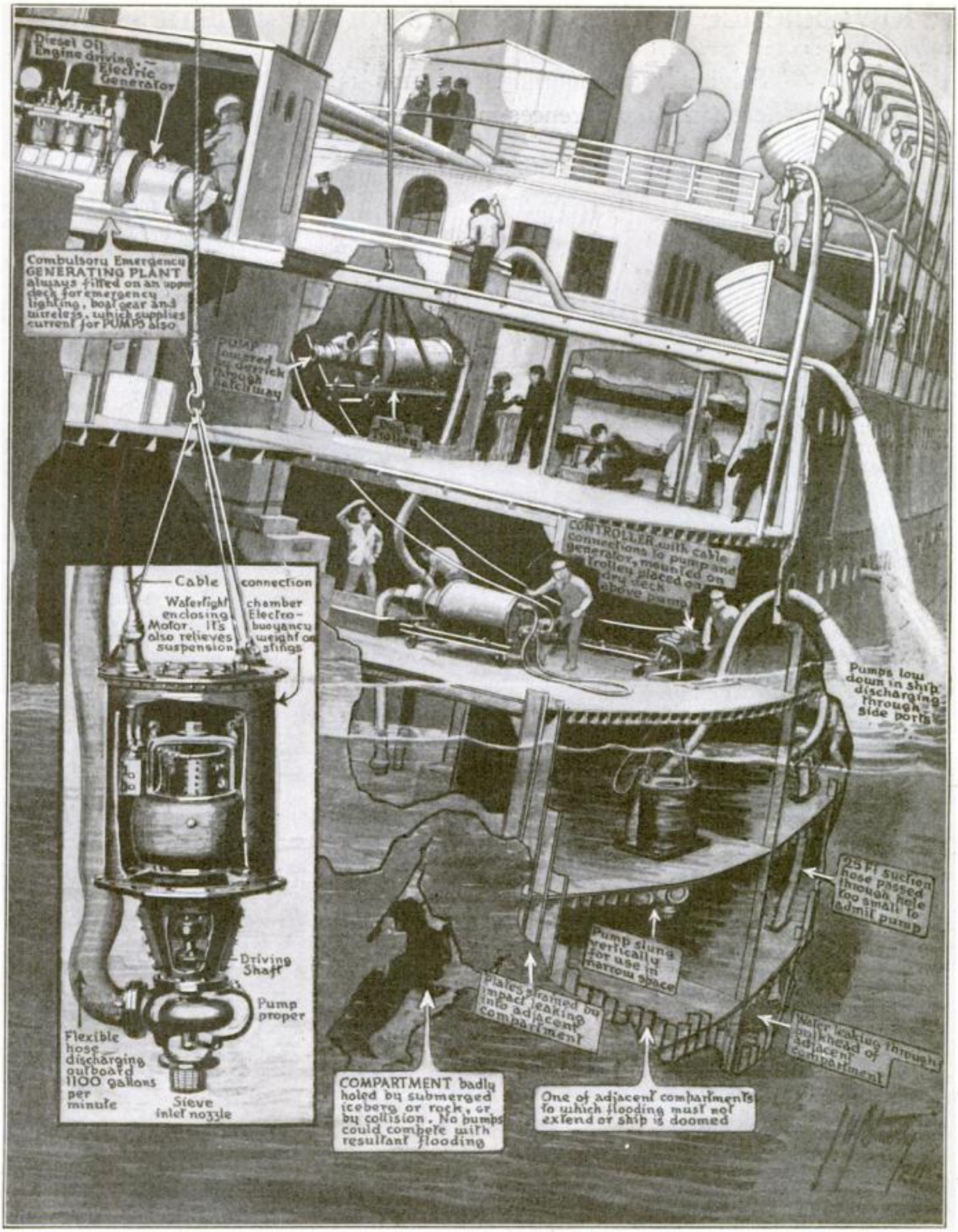
When the chips of mica are pressed into compact sheets it is impossible to keep flaws from forming, and the only way to prevent the damage when these defective sheets are used is to detect the flaws in advance. The most effective way to do this is to subject the mica to an X-ray examination. For that purpose the General Electric Company has devised a special apparatus.



The X-ray cabinet in which sheets of mica used in electrical machinery, are examined to detect flaws

It consists of a cabinet in which the operator views the tray of mica sheets as the rays passing through them bombard the fluorescent screen. To protect the operator from the injury of continuous service the X-ray tube and exposed parts are encased in lead. There is an opening for the rays which pass through the mica to reach the screen. Under the screen is a mirror tilted at an angle of 45 degrees and the operator sees the reflection of the screen. The trays are automatically controlled and when being changed a lead shutter automatically moves to close the window through which the rays would otherwise pass and injure the glass of the mirror.

Flaws in the mica appear black and sharply outlined, while small holes in the sheet can be readily detected.



Pumping Out the Water Faster than It Pours in

When the ship is leaking badly, and is rapidly sinking after a collision with an iceberg, or other catastrophe at sea, the new centrifugal pump may save her and the lives of all on board. It is designed for use in just such emergencies, when water is rushing into the hold faster than it can be driven out with an ordinary pump and where other pumps may be rendered useless

It has a working energy each minute equal to the combined effort of twenty-six horses, when operating in the depths of a large steamship, like the one pictured, where the water must be lifted to a height of 90 feet to be discharged. It is adaptable to difficulties. When it is impossible to lower it, a suction hose is passed down into the hold and the pump is operated on deck

How Science Settles Disputes for the Business Man

Solving manufacturing problems and adjusting economical differences in the Bureau of Standards

By S. R. Winters

THE government Bureau of Standards is a busy referee. It settles disputes between employer and employee; between producer and consumer, between representatives of various kinds of business, between importers and exporters, municipalities public-utility corporations, states and cities; and between nations, when it is called upon to do so.

The Bureau merely applies the yard-stick, the electroscope, or the thermometer, to adjust countless differences of opinion, more or less serious.

It facilitates precision in science, and assumes a high rôle of authority in standards of measurement, standards of quality, and standards of mechanical performance.

What is the relative usefulness of gas of 565 British thermal units per cubic foot and gas of 22 candlepower? One concerns the heating power and the other the illuminating power, and the answer from the Gas Engineering Section of the Bureau of Standards decides the relation between the two. Granted that the appliances for lighting or cooking are properly adjusted and the quality of the gas uniform, there should be enough heating and lighting value in the gas to make the gas useful for ordinary purposes.

New Standards are Investigated

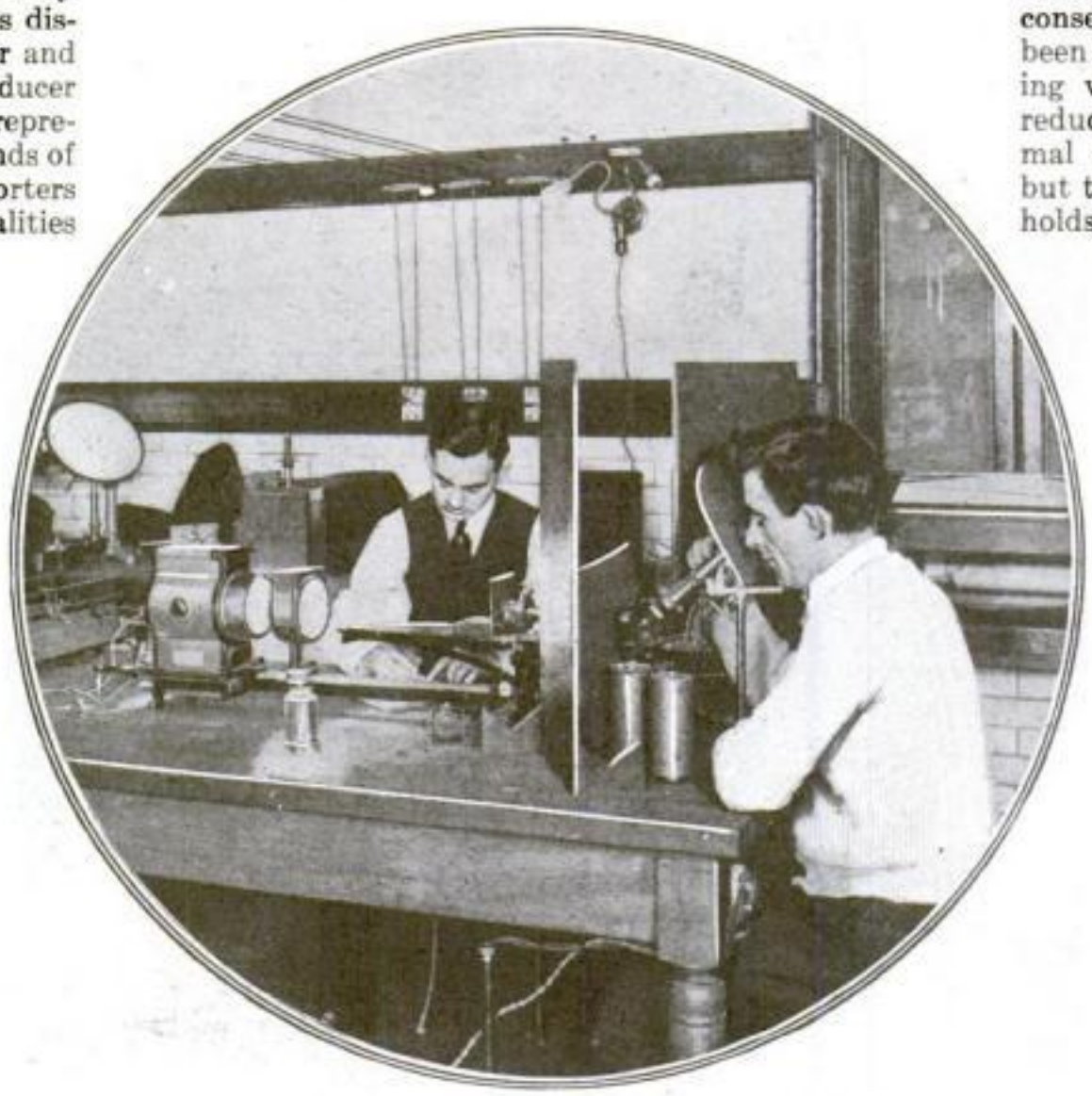
The huge demand for the by-products of oil far overreaches the supply. From gas many of the same substances can be taken, and the very great need for them in industry necessitates robbing the gas of much of its original value. The brilliant flame of the old-time fish-tail burner wasted the rich benzol and volatile by-products. To conserve them today, it has been suggested that the heating value as a standard be reduced to 528 British thermal units to a cubic foot, but the Bureau of Standards holds this a radical change of doubtful wisdom.

Controversies have arisen as to the influence of temperature in coke-making, upon the characteristics of the coke and the quantity and quality of gas produced.

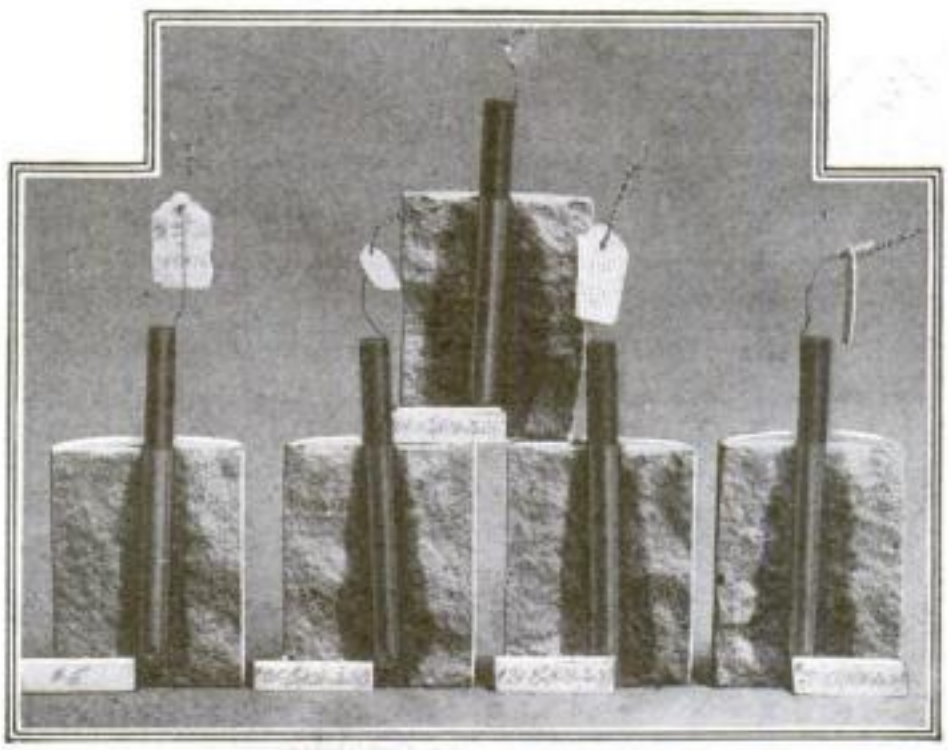
Heating Values of Gas

Recently the Bureau of Standards conducted tests at the Sparrows Point Plant of the Bethlehem Steel Company, and it was found that gas produced at high temperatures indicated greater value but less *heat* value than gas produced at lower temperatures, while the coke produced at low temperature is very inferior to other coke. The making of gas at high temperature tends to cause a greater decomposition of its less volatile material into gaseous elements, and results in a complete elimination of the more volatile substances. The slow cooking of coal at a lower temperature gives off the lighter gases first, each increase in the degree of heat bringing forth the heavier constituents of the gas imprisoned in the coal. Application of intense heat at once changes the physical structure of the molecule, literally "cracking it" into different combinations and producing different substances, more valuable to industry perhaps, but possessing less value as a gas to furnish heat for cooking, power, etc.

Down in the coal region of the Cumberland fields



Here, under the spectroscope, the Bureau of Standards decides matters of color controversy. The quality of many substances figures prominently in their precise color, or the spectrum which they give. In the laboratory of the Color Section disputes on this question are settled by men skilled in this work



The electrolysis of gas and water pipes has been the cause of many disputes which have been carried to the courts. The Bureau of Standards has worked out plans to prevent this unnecessary damage and avert these controversies

of Maryland, the miners threatened to strike, charging short-weight measure in their day's output of coal. A representative from the Commercial Scales Section of the Bureau of Standards was detailed to test the mining scales. Inaccuracies in the scales were not only detected, but the strike was averted, and the coal operators pleaded guilty to grand jury indictments of serious discrepancies in the mining scales. The master offender paid a penalty of $900.

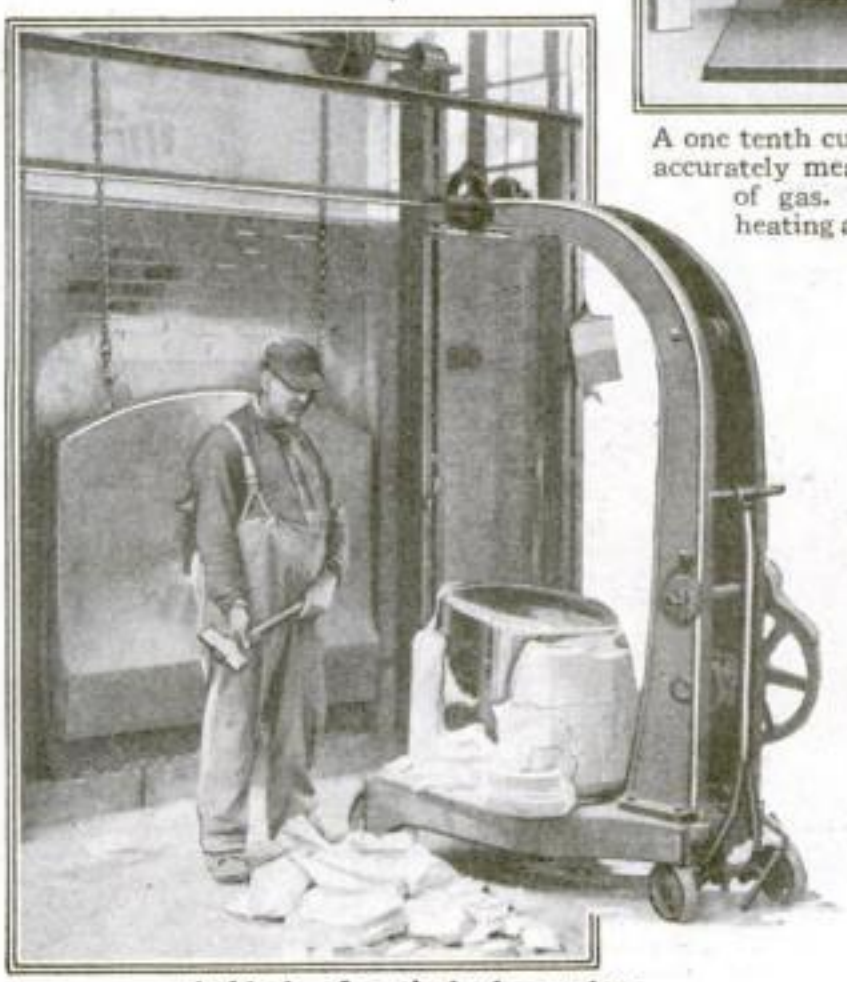
Railroad master scales throughout the country have been tested and serve as a standard for practically all railroad weighing in the United States

The Sugar Content of Molasses

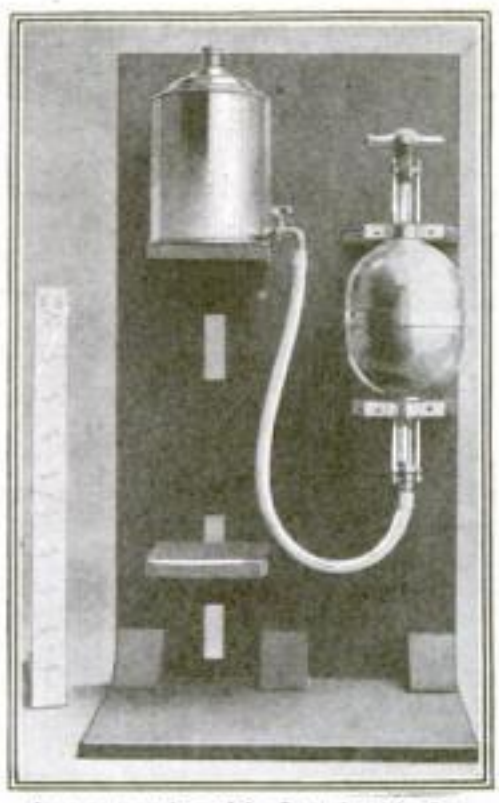
From Cuba the United States imports its "blackstrap" molasses, the product being shipped by rail in tank-cars and vessels. Cuban exporters are under contracts to supply molasses with a certain sugar content. Disputes have arisen between the buyers and sellers as to the quality of molasses and whether the sugar content specified is present. The Polatimetry Section of the Bureau of Standards acted as referee and made sixty-one analyses during 1919. The standard for the decisions is essentially that the value of molasses is predicated upon its thickness. An instrument, described as a picnometer, has been developed whereby entrapped air can be displaced and the density of molasses determined with scientific precision.

A tide-motor corporation, claiming as its proverbial right the earth and a fence around it, was subjected to an exhaustive investigation, the Bureau of Standards acting in response to a request from the United States Post Office Department. The claims of the company were exploded and the use of the mails denied the promoters in advertising the instrument.

The street railways of the United States are operated on the single overhead-trolley plan, with the electric current flowing into the rails through the car wheels after passing through the motor-cars. The current then retraces its steps to the generating station, after spreading through underground gas and water-pipes. The result is endless litigation because of damage created by this electric current. The Electrolysis Prevention Section of the Bureau of Standards has amicably avoided litigation between the public-utility corporation and the city authorities of Wilmington, Del., by having the street-railway company adopt the three-wire power distribution system to avoid electrolysis troubles.



A block of optical glass taken from the melting-pot to be tested



A one tenth cubic foot bottle for accurately measuring the value of gas. This determines heating and lighting values

Supplementary protection to the cables has achieved the results desired.

Even international disputes and scientific discrepancies are not outside the domain of adjustment by the Bureau of Standards. The Polarimetry Section has discarded the use of the time honored 100-degree sugar point established at the Sugar Institute in Berlin. An error of more than one tenth of one per cent. has been revealed, the discovery meaning a saving of $70,000 annually in revenue to the Government, and to the producers perhaps untold millions of dollars.

Important Work the Bureau Has Done

The instruments at the various customs laboratories for the collection of revenue on imported sugars have been corrected in conformity with the newly accepted standard of value. Prior to this scientific adjustment, the fundamental constant in testing of sugars for purposes of buying and selling throughout the world was the so-termed 100-degree point. This standard is determined by a precision measurement using chemically pure sugar.

While ascertaining the cause of certain anomalies in the testing of sugars, the Bureau of Standards discovered the discrepancy in a business in which the United States Government collects $90,000,000 in revenue annually.

The Government Bureau of Standards not only comes to the rescue of persons and communities involved in a dispute, but it takes the important rôle of benefactor in scientific matters. Difficult problems are attacked in the laboratories of the Bureau, and a general advancement of science in invention is the result. Not only are standards of weight, measurement, and quality established, but workable improvements in various lines of industry are advanced. From the testing of optical glass to that of carburetors, the Bureau occupies an important place of utility.

Specialists of repute in all lines of research are employed in the laboratories. They carefully study a problem and solve it if possible. They not only give to the country its standard yard, candle, and the standards of liquid measurement, but they apply these units in unraveling the problems.

Camping Out for Lack of a Home

PEOPLE who find that moving day has arrived and they have no place to move into, are driven to a quick make-shift for a house. If they are fortunate enough to own a lot, a temporary structure is sometimes hurriedly built; or a garage does duty until the home is constructed.

An American family in England made a home of two covered wagons that served for kitchen and livingroom.

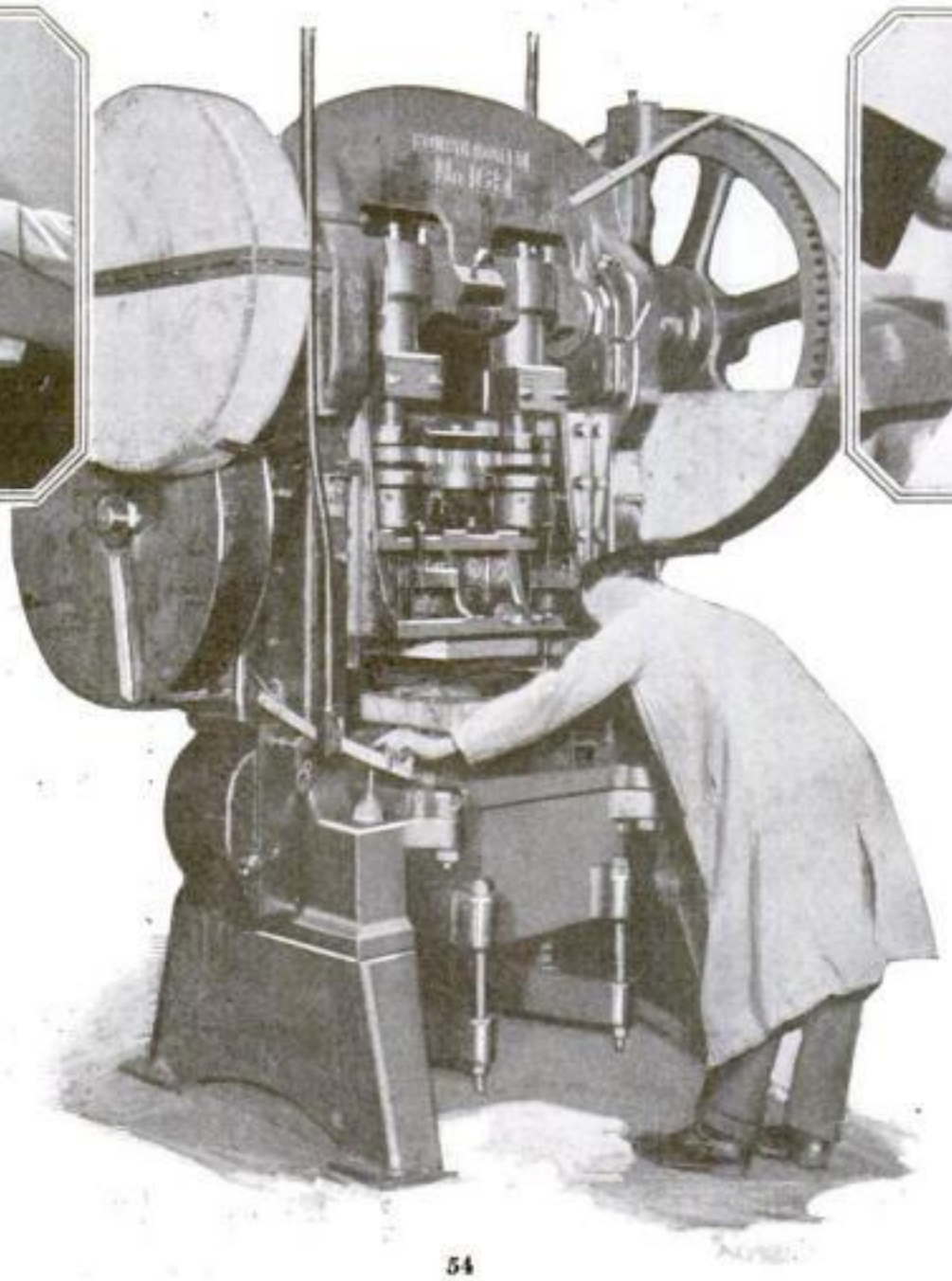
A Castle Built in Miniature

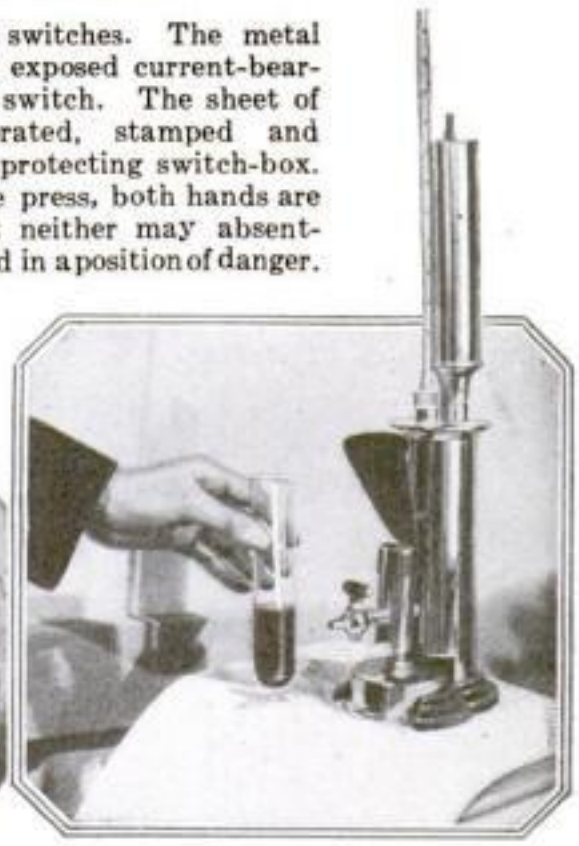
"MAN wants but little here below," but he must not want it too long, too high, too wide, nor with too many frills on it. This is evidently the idea of the man who built a miniature castle for a house. The entire building occupies no more than 20 by 20 feet of space. It has an inner court 5 by 10 feet. The "castle" cost less than $300 to construct.

Safety First and Second in This Machine

A POWERFUL motor-operated side press protected with a special safety device, the press being used to make another safety device, illustrates to what extent the "safety first" idea is penetrating modern industry. Here a steel box is being stamped, the box being intended as a safety covering for electric switches. The metal box encloses the exposed current-bearing parts of the switch. The sheet of metal is perforated, stamped and shaped into the protecting switch-box.

To operate the press, both hands are required so that neither may absent-mindedly be placed in a position of danger.





The Pen Clings to the Desk Magnet

ARE you always losing your pen? Hang it on a magnet. Then hang the magnet on your desk lamp. The outstanding feature of a magnet is its power to attract steel and iron. Since a penholder is usually made of light stuff it will dangle indefinitely at the end of its pen point when the pen point is in the clutches of a magnet. It will be there when you look for it. To loosen the pen, give it a slight tug and it will be released from the magnet none the worse for its hanging.

Testing Drinks for the "Kick"

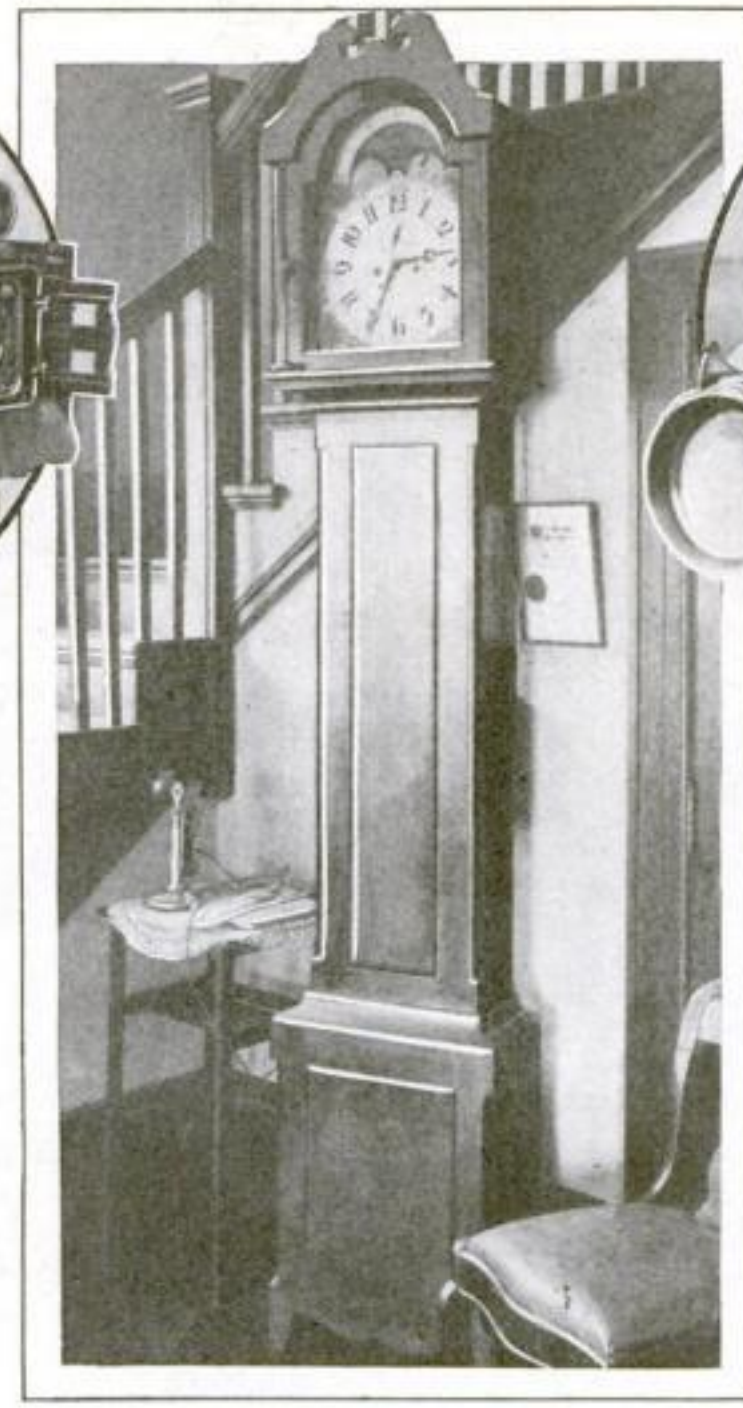
WHEN it was found that some of the 2.75 per cent beer had apparently developed a higher per cent of alcohol after having been stored, a rapid means of testing for the "kick" was devised. It was also necessary to have a means of investigating the nature of near-beer which looked and tasted exactly like real beer.

When a drink undergoes this test, a small meter on the side of the test-tube records the percentage of alcohol it contains.

Making Sharp Pictures through a Telescope

THERE are several ways to focus a camera to obtain sharp pictures but one of the best is that which employs a telescope of small size. The lens of the telescope has the same focal distance as the lens of the camera so that when the photographer looks at the ground glass at the eye-end of the telescope he sees the same field of view as is shown on the ground glass of the camera.

Racking the bellows of the camera in or out until the image appears sharp and distinct in the telescope makes the image sharp and clear on the ground glass, and on the film or plate when it is put into position.



Wind-Shields Insure Warm Hands at High Speed

POLICE Sergeant McCormick is the star motorcycle driver of Washington and he escorts many distinguished visitors around the city. In the winter time he has found that in spite of his fur-lined gloves his hands are often numbed by the cutting wind. So he has fastened to the handle bars of his machine two round leather wind-shields.

His hands no longer grow numb, and he continues to be the star driver. Other drivers on the police force have adopted the clever idea of Sergeant McCormick, and have wind-shields on their motorcycles. They eliminate a discomfort all motorcyclists know.

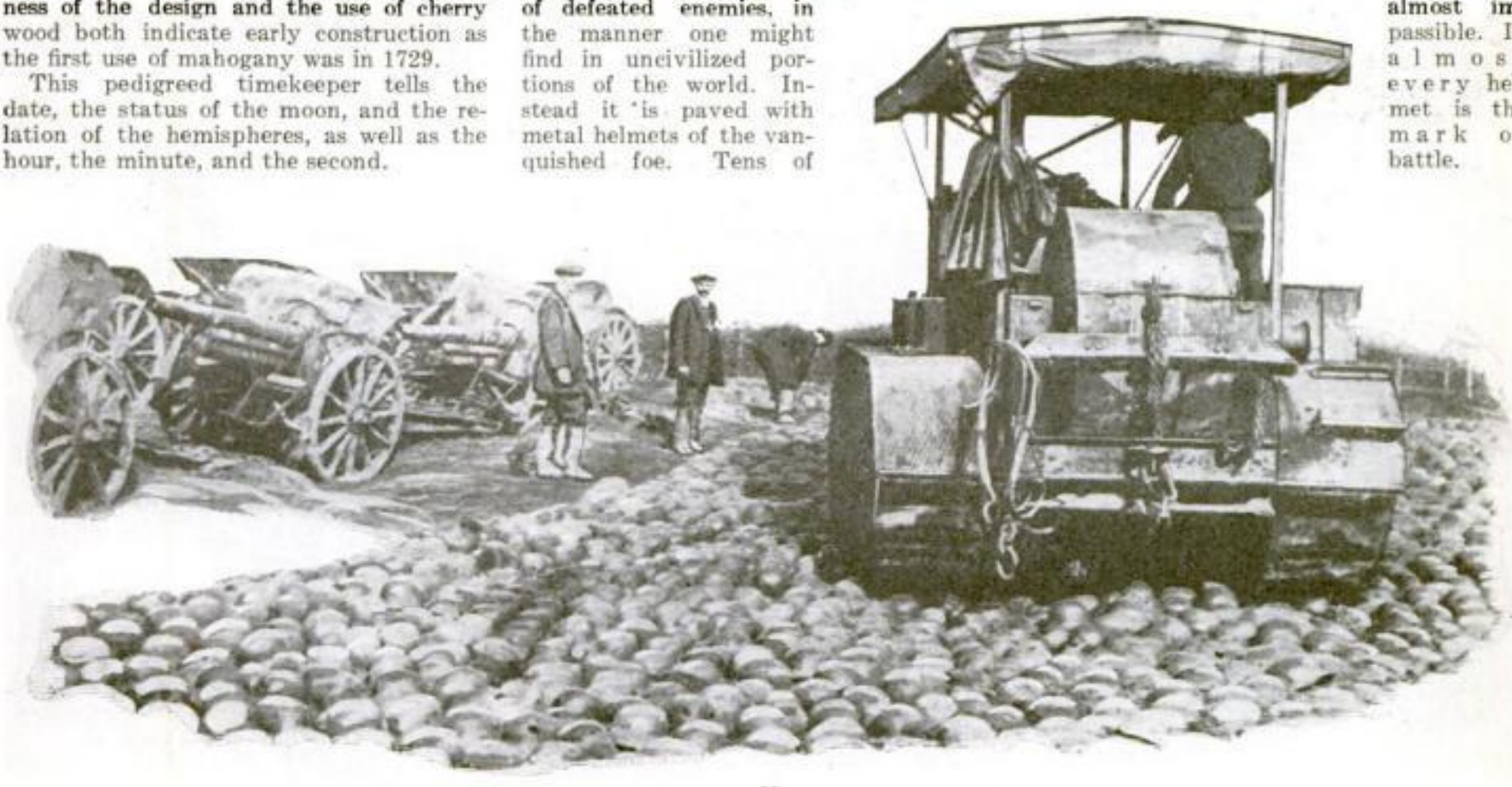
The Oldest Clock in America Discovered in Atlanta

ANTIQUARIANS recently discovered at the home of Mrs. P. H. Mell, in Atlanta, Georgia, what is believed to be the oldest clock in America. The plainness of the design and the use of cherry wood both indicate early construction as the first use of mahogany was in 1729.

This pedigreed timekeeper tells the date, the status of the moon, and the relation of the hemispheres, as well as the hour, the minute, and the second.

Paving an English Road with German Helmets

TEN miles south of London Bridge in the township of Croydon is the most remarkable road in the world. It is not walled-in with a long row of spikes upon which are gruesomely displayed the skulls of defeated enemies, in the manner one might find in uncivilized portions of the world. Instead it is paved with metal helmets of the vanquished foe. Tens of thousands of German helmets were taken there in the closing days of the war. These trophies have been put to useful service in making a good road where otherwise would be a stretch of mire almost impassible. In almost every helmet is the mark of battle.



Use Coat-Hangers on Moving Day

MOVING day, afoot, required lugging many drawings, sheets of drawing paper and miscellaneous materials tied to a drawing board so wide that carried at the side under one arm, the fingers barely reached its lower edge. An ordinary coat hanger solved the problem of carrying it. The hanger was inverted and its wire loop was hooked under the board.

Customs Officers Look for Smugglers of the Air

IN Europe the airplane has become such a common vehicle of travel that countries are guarding against smugglers who might use the air highways.

Airways would seem to be ideal for the smuggler. But landing-places are watched, and when a pilot descends the contents of his luggage are examined for contraband material. Customs officers greet the aviator at all landings.

The Baby's Carriage—with Variations

BABY carriages in Germany get plenty of wear. In most cases they are bed and carriage combined.

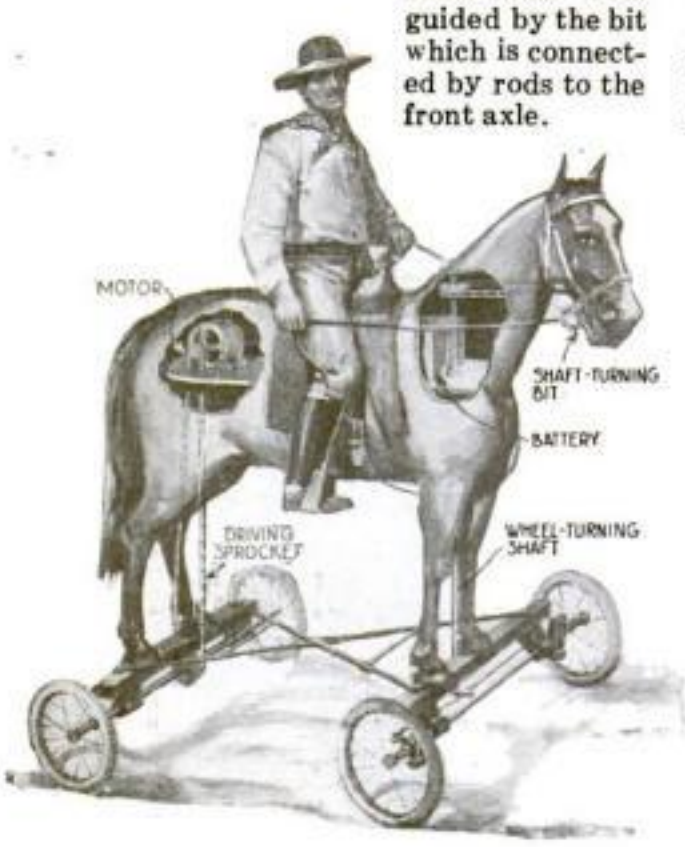
Behold the nursemaid above. When she came in from her walk she found that baby was fast asleep. And so she simply lifted out the body of the carriage, carried it indoors, and placed it gently on the floor. Baby continued to sleep, undisturbed.

This Horse Eats No Oats

A HOBBY-HORSE must have been the favorite toy of Charles Johnson, of San Diego, California, for as soon as he reached the age of invention he patented a motor-driven horse on wheels.

It is a full-sized metal one and its body is loaded with gears, chains, rods, and batteries.

The horse keeps the steering apparatus in its head. It is guided by the bit which is connected by rods to the front axle.



You Can Buy Your Stamps at the Mail-Box

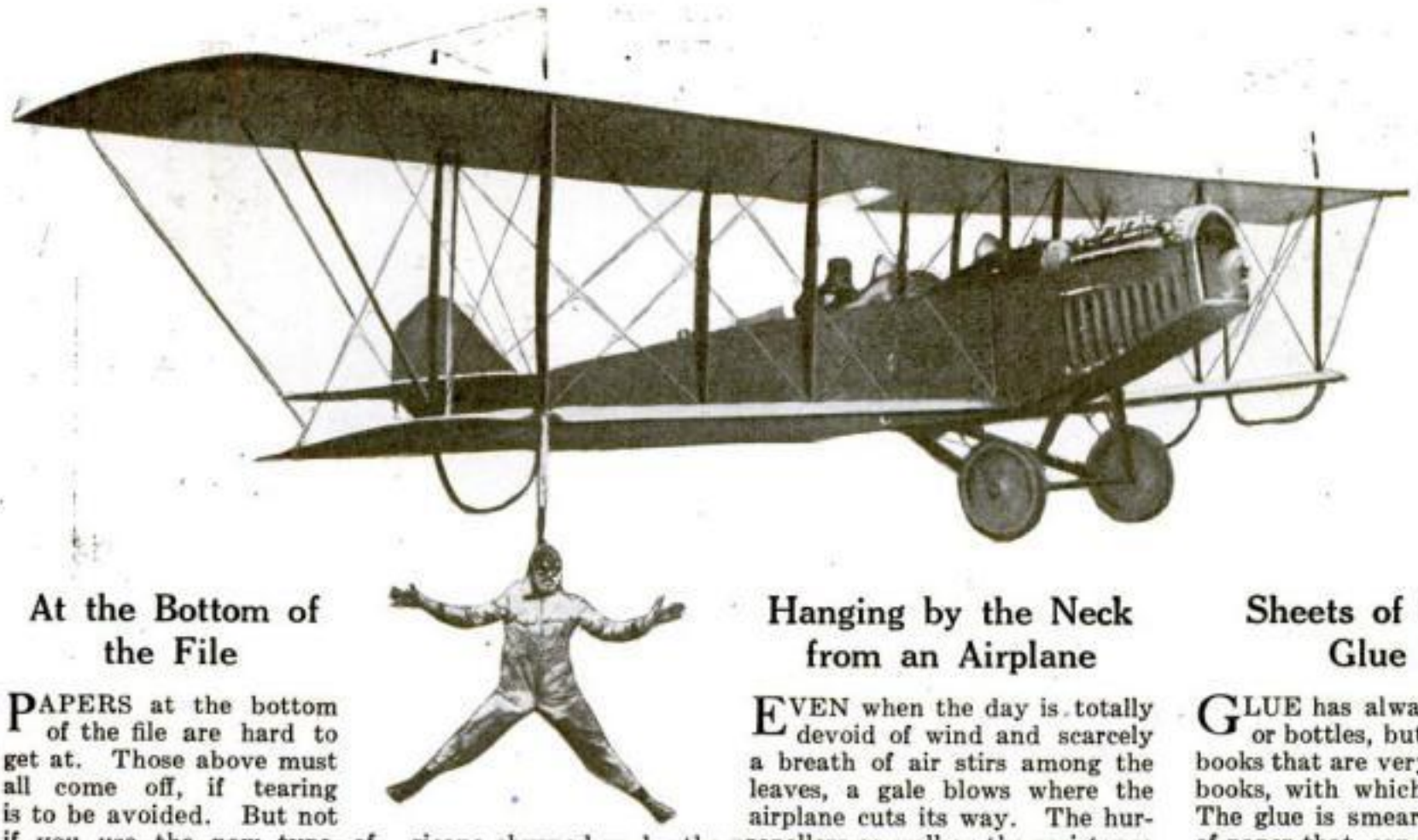
"GOT a stamp?" That is one of the eternal questions. There are plenty of mail-boxes but comparatively few places where you can buy stamps. On Sundays there are almost none.

But in Toronto, Canada, you can get your stamps at the mail-box. Just above the metal flap marked "letters" there is a slot machine.

An Elk Is His Trusty Steed

BUCK McKEE, is the rider, and he raised the elk himself, and broke him to the saddle. But Buck was once a Texas ranger, and breaking wild steeds is easy for him.

The elk is not shod like horses, but wears sandals devised by his owner to protect his feet on hard pavements; for Buck sometimes rides his elk into town, when, needless to say, he creates a sensation.



At the Bottom of the File

PAPERS at the bottom of the file are hard to get at. Those above must all come off, if tearing is to be avoided. But not if you use the new type of spindle file here pictured. The spindle has a curving branch near the lower end off which the bottom paper may be slipped when the hollow spindle is lifted from its support. The double end file is particularly useful in grocery and department stores where telephone orders are filed in the order of their receipt.

Hanging by the Neck from an Airplane

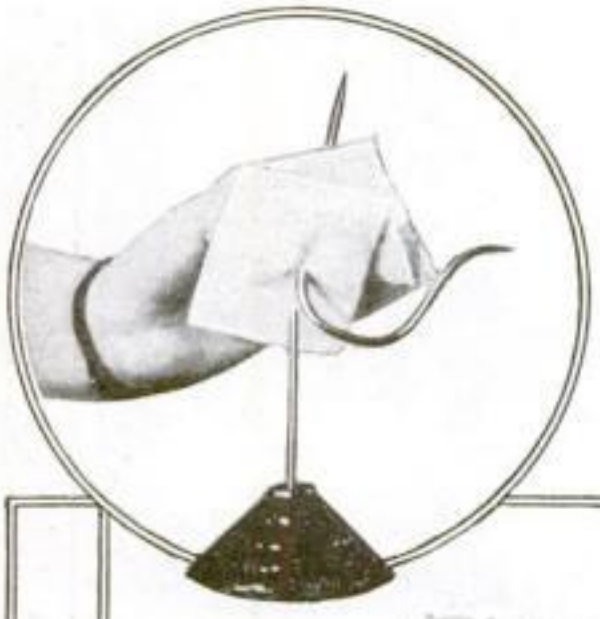
EVEN when the day is totally devoid of wind and scarcely a breath of air stirs among the leaves, a gale blows where the airplane cuts its way. The hurricane churned up by the propellers as well as the resistance offered by the machine creates a violent wind which beats in changing directions across the persons in the fuselage if their position is exposed. When one realizes the strength of this artificial wind he can realize the difficult task of the acrobat who ventures to do "stunts" on the wings of a moving airplane.

Lieutenant Roscoe Turner was carried through the air hanging by a strap attached to the plane and to a support at his neck. If the engine had stopped there would not have been time for him to get back upon the wing of the airplane. His position would have been extremely perilous.

Sheets of Glue in a Glue Book

GLUE has always come in tubes or bottles, but now it comes in books that are very much like stamp books, with which you are familiar. The glue is smeared on thin sheets of paper that can be torn out of the book when they are needed. Both sides of each sheet are smeared.

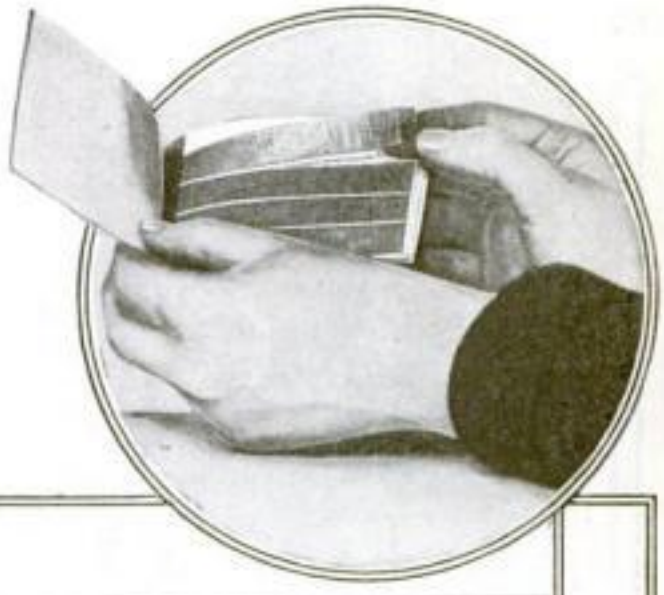
After all, a stamp book is half glue book and since it is a great success, the glue book should be one too. A strip when moistened on both sides will fasten two sheets of paper together, or may be used for mending clothes. The busy housewife can do emergency mending quickly if she has a glue book.



Water, Water Everywhere

GERMANY'S rivers have, in many places, welled up and flooded the land. Even the much-loved Rhine has joined the ranks.

At Coblenz everything that isn't fastened down is floating. The American army trucks that were standing in the automobile park at the time of the flood are now almost completely hidden. Just their canvas tops may be seen. The overflowing rivers of Central Europe have done nearly as much damage as the war.



The Wireless Alarm-Bell for Danger at Sea

Just as a burglar-alarm summons help, so the new wireless alarm-bell summons aid from ships within a radius of a hundred miles. The wireless operator of the doomed ship presses a special key and a continuous call goes out automatically.

This key actuates a special receiver on all the ships similarly equipped, and an alarm-bell rings in the wireless cabin of each ship. The operator rushes to his seat, disconnects the special receiver, and waits for word of the doomed ship's position.

The wireless operator who is sending out the distress call waits until he is sure that the alarm-bell has sounded and then he gives his position and the condition of the ship. The device is an automatic S. O. S.

Ringing Alarm Bells Across Miles of Sea

No longer need the wireless operator be constantly on watch at sea

THE persistent clanging of a bell arouses the wireless operator from his sleep. In a moment he is at his instruments:

"*Gigantic* answering. Ready for message."

The purring radio sends the response out in rapid repetition. There is a pause for answer. The alarm-bell stops clanging, and in its place comes:

"Steamship *Breton* calling. Sinking. Lat. 35 13 North; Long. 75 17 West. Hurry!"

A dash for the bridge, a quick consultation with the watch officer, and the *Gigantic* is off at full speed to the rescue.

It will be in some such setting as this that a new wireless invention will prove itself, making it possible for ships at sea to eliminate the expense of having a radio operator always on watch, and yet keep an ever open radio ear to calls of distress.

The device is in the nature of an attachment to existing types of ship radio equipment. Ships carrying it will have an automatic transmitting relay. Press a key, and it fires 180 dots a minute into the ether. The magnets of the relay are controlled by a special contact-maker. This is formed by a brass flywheel within which is an iron bar. The wheel carries a brush for making contact with a stud, thus closing the battery current through the magnets of the transmitting relay. This contact is not normally open, the wheel being held in the proper position by a spiral spring. A pair of electromagnets act on the iron bar. If they are energized, the wheel turns still further away from the position in which contact is made. While so turning the spring winds up. The current to these electromagnets is controlled by the brush on its flywheel.

Now, suppose the wheel is turned by hand from its normal position until contact is made. Its electromagnets energize; the iron bar armature swings in the magnetic field, opening up the contact and winding up the spring. But opening the contact has de-energized the magnets. The spring now whirls the wheel back through its original position until contact is made again. And so the process repeats itself a number of times a second, depending on the inertia of the flywheel and the tension of the spring.

Each time the wheel turns so as to make contact, the transmitting relay operates, and a dot is sent out by the regular radio equipment of the ship.

Instead, however, of starting the contact-maker by hand, a short-circuit key is provided, which allows the coils to energize. Pressing the key causes the spring to wind up; releasing the key allows the contact-maker to operate as an automatic transmitter.

Such was the operation on the ship whose distress call the *Gigantic* had picked up. On the *Gigantic* the operator, before going to sleep, had left his receiving circuit in operating condition and had thrown a switch that connected a three-stage amplifier in place of the head receivers. This amplifier feeds into an automatic receiver which is built on the same principle as the transmitting contact-maker.

A dot energizes its magnets, turning a light flywheel until contact is made by its brush. During the interval following the dot, the spring whirls the wheel back, ready again for the next dot. Each time the brush makes a contact, it closes the same transmitting relay as is used in sending distress signals. But this relay is now hooked up to close the circuit of an alarm bell.

The receiving mechanism must be adjusted to have the same time of oscillation for its flywheel as the transmitter of a ship from which it receives.

Finding the Range in Miniature

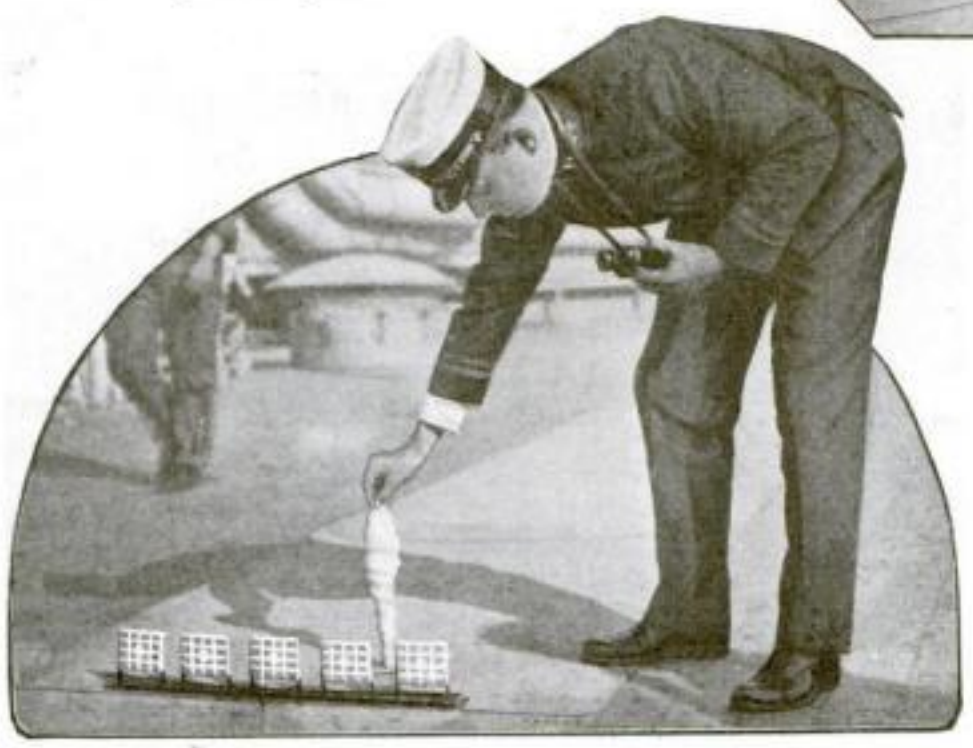
"UP 50!" calls the officer. "Down 20!" he shouts again.

He is not gazing toward the open sea, but is merely looking down the deck toward a miniature target at which imaginary shots are being fired.

Officers in charge of a battery must be trained in the difficult art of range-finding. The miniature target practice helps to train the officer and make his work far more accurate when the actual firing at targets at sea is conducted under his charge.

At the end of a clear stretch of the deck is placed an exact miniature reproduction of the large targets used at sea. The officer who is to be taught an accurate judgment of distance looks toward the target through marine glasses. He lies flat upon the deck to bring his eyes in line with the target. The instructor who is to check the results of the observer stands near the target and places before or behind it a roll or wad of cloth which is shaped in the correct proportion to represent a "splash" caused by the falling shell. Inches represent so many yards, and if the splash is between the observer and the target he will call "Up," and state the estimated number of yards short of the mark. If the splash is back of the target he calls "Down" and gives the number of yards beyond.

The officer being trained in observing the results of firing the big 14-inch guns. Miniature targets are observed through the glasses, the observer lying flat upon the deck to make observations



The targets are placed far down the deck from the observer. An officer standing near by checks the range as it is called by the observer, the shots being marked by an artificial splash made of cloth thrown up as they fall

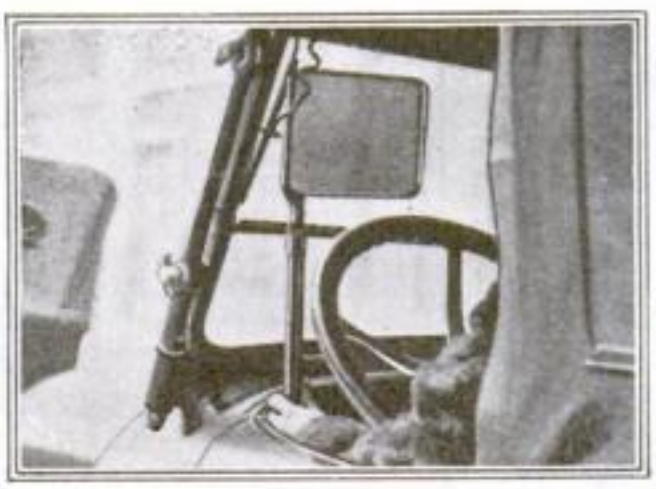
New Jobs for Old Photographic Plates

After you have washed off the emulsion they are ready to start

Next time you have your picture taken, ask for the plate. Wash it off and you will have just the right-sized piece of glass to frame for many purposes

Would you like to turn your back porch into a sun parlor like this one? Build the framework and then fill up the gaps with photographic plates. A small conservatory could be built of old plates and the necessary framework of wood to support the walls and roof

Glass table tops are now in vogue, but they're costly. How would you like to get one for ten cents? All you need is some cement with a few photographic plates



If you drive toward the sun, its glare will blind you. One motorist fastened a strip of green celluloid to an old photographic plate and mounted it on a stand in front of him, to soften the glare in his eyes

Sometimes strawberries are preserved by exposure to the sun. While exposed they must be covered over with glass. Use old photographic plates to cover them

Should you take a picture of a beautiful scene have a positive made of the negative, on glass to hang in the window. The old negative protects it. The two plates are framed together

You can let in the fresh air but keep out drafts with a glass screen like this, made of two old photographic plates held together with cement. Transparent cement should be used

Keeping Up with the March of Science

Facts for the man who wants to know

Solving the Paper Shortage

WHEN cotton is ginned to remove the seed, linters are obtained—seventy five pounds of linters to a ton of seed. Germany used to buy from us half a million bales of linters for the making of explosives. Our own uses for the material were more peaceful—stuffing mattresses, cushions, horse-collars, and upholstery. When the war came, we also had to use linters for making explosives.

The signing of the armistice found us with 12,000,000 bales of linters on our hands. What was to be done with them? The financial loss involved was $280,000,000. The answer is supplied by the Bureau of Standards and the Forest Products Laboratory. "Make paper," it reads.

The Bureau of Standards admits that the first experiments yielded only a mediocre paper, but new developments indicate that linters can be used in the making of magazine and book papers.

We fancy that we hear cheers from the magazine publishers.

On Shoes and Feet

PROHIBITIONISTS and other reformers have worried much about our morals, but very little about our bodies. We direct their gaze to their own feet.

Alcohol is bad for the mind and soul. The shoes of to-day are bad for the feet and the body. Physiologists have tried to make men and women wear sensible boots, but no one pays any attention to them except a few health "cranks." Ninety-five per cent of the women of this country have foot trouble in some form because of high-heeled shoes. Efficiency is reduced from ten to fifty per cent, as a consequence, according to the American Museum of Safety. What is more, correct walking is almost a lost art.

After the world is dry and tobaccoless, perhaps the Constitution will be extended to include an amendment covering the case.

The Slump in Mice

DURING the war thousands of mice were caught and bought for medical experimentation. The breeding of mice became a profitable industry. Now that the war is over, the breeders are "long" on mice and are carrying large stocks.

The scientists who are administering the George Crocker Special Research Fund, taking pity on the breeders, are trying to ship mice to he Imperial University of Tokio—as if Japan didn't probably have enough mice of its own.

Wanted: A Map

EVERYBODY supposes that the United States has been thoroughly mapped. The truth is that only forty-two and one half per cent of the area has been surveyed. That is why a map-making conference was recently held in Washington to discuss the Geological Survey's topographic program.

It will cost $40,500,000 to complete the map of the United States and to make certain necessary resurveys and revisions. If the Survey's program is carried out we may have a scientifically prepared map by 1932.

Without accurate maps it is a very difficult matter to lay out and establish highway systems.

Living Five Hundred Years

THE thyroid gland seems to be a kind of switch that controls both the rate and form of animal growth.

An idiot (cretin) at the age of twenty years may be no larger than a child of six and possess the mental powers of a baby. Feed him with thyroid extract and he becomes a happy, healthy child.

Tadpoles fed on thyrod turn into frogs long before their time. Remove the thyroid from the tadpole and it refuses to become a frog at all, but grows and grows until it becomes three times as big as an ordinary tadpole. The axolotl, a fish that is a staple of diet in Mexico City, and that normally grows up into an undeveloped tadpole-like form, with gills and with a fin to its tail, can be turned by thyroid at will into a salamander-like creature, living on air and breathing with lungs.

If we only knew more about the thyroid we might be able so to control growth that we could live five hundred years. Life's processes and the thyroid gland are inextricably bound together.

Filtering with Spun Glass

FINE, sharp sand in oil from the Gulf Coast region cuts barrels and fills tubing.

Recently experiments have been made that prove that spun glass is able to filter out the finest particles. What is more, tiny water globules are increased to such a size that it becomes easy to get the water out of the oil.

No More "Listening In"

IT is easy to "listen in" on the telephone. Indeed, "listening in" is a favorite pastime in rural districts. Captain Poirson, a French army engineer, has overcome the telephone's one drawback by deforming the electric pulsations that travel over a wire and restoring them to their correct form at the receiving end. Listen in as much as you like, the conversation is unintelligible.

Deformation of the message was easier than reforming. Excellent results have been obtained with Captain Poirson's apparatus over the Paris-Bordeaux line, which is about one hundred miles long.

Folding Wings for Airplanes

WHEN a flying-machine that has crossed the Channel from England to France lands at Le Bourget, formalities follow that recall the endless ceremonies of entering a harbor by steamship. There are signals from lighthouses, warnings from weather bureaus, customs officers who cross-examine passengers, toll-collecting, and the payment of harbor dues.

The big Handley-Pages, which can fold their wings back in a very birdlike way, have at least one advantage over their smaller competitors. Harbor dues are assessed on the basis of the number of square meters occupied.

What does the big Handley-Page do? It simply folds back its wings and pays the minimum!

What Became of the Bison

GEORGE CATLIN, an authority on Indian life in the middle of the last century, stated that in the 1830s from 150,000 to 200,000 buffalo robes were marketed annually, which meant a slaughter of 2,000,000 or 3,000,000 bison annually.

The death-knell of the bison was sounded when the Union Pacific Railroad was under construction. The road made marketing of the robes easier and divided the northern and southern herds.

By 1875 the southern herd, consisting of at least 3,000,000 animals, had been exterminated. By 1889 the northern herd, too, was practically extinct, its actual numbers being placed by Dr. Hornaday at 635 animals.

Dr. C. Gordon Hewitt, of the American Museum, calls this "the most striking and appalling example of the fate of an animal existing in apparently inexhaustible numbers, when left exposed to unrestricted slaughter."

Left Over from the War

LIKE most European cities, Paris mounted numbers of sirens during the war in order to sound warning of impending airplane raids. What is to become of the sirens, now that the war is over?

The officials of Paris are thinking of distributing them among French villages, where they are to serve as fire-alarms.

American papers please copy.

The Elephant's Future

THE elephant is an animal that is extinct, in a sense, and doesn't know it. He belongs to a past geological age. A knight in clanking armor on Main Street is no more of an anachronism.

If Africa continues to develop as rapidly as it has been doing, its elephants will soon be reduced to the status of curiosities, like the American Bison, with the

difference that the bison can be more easily kept in captivity than the elephant.

It has become necessary to destroy a herd of about two hundred elephants in the Addo Bush Forest Reserve (South Africa), a herd that was the last remnant of a variety that once roamed all over southern Africa.

The immediate cause of this was the opening of Addo Bush to agriculture by irrigation projects. Since the elephants would not behave, and since their confinement would have entailed the building of a thirteen-mile fence at a cost of $100,000 and the provision of a water supply, they had to go.

About a Roomful of Air

NOVELISTS and poets use the air as a symbol of lightness. "As light as air," "as thin as air"—how many times we have read the phrases!

When next we meet a novelist, we'll ask him whether he could carry a roomful of air if it were compressed into a dress-suit case.

Of course he will boast of his ability to do so. And then we will hold this novelist up to scorn and snap our fingers under his nose and say, "That for your knowledge!"

Air weighs seventy-five pounds a thousand cubic feet. A room that measures twenty feet long by ten feet wide by twelve feet high contains one hundred and eighty pounds of air.

A New Use for Ticket-Holders

THOSE flexible commutation-ticket holders with celluloid windows flashed every morning and evening by suburbanites, have an industrial use.

The "job ticket," which travels with a piece of work through a factory, and which constitutes a record of machine operations, is one mass of oily smears when it reaches the end of its journeys, despite the "Keep Clean" notice printed on its face.

Now the job ticket travels in a holder with a celluloid window and arrives at the accounting office with a reasonably clean face.

Try it in your factory.

In Praise of the Peanut

THE peanut used to be regarded merely as a trimming for the circus. Since the war it has become a valuable food product. Salad oils, oleomargerine, soap, and cooking compounds are now made of peanuts.

One company timidly experimented with a carload of peanuts ten years ago; now it consumes annually three hundred carloads. Last year twelve Southern States planted peanuts on 1,251,000 acres and grew a crop worth $80,000,000. A peanut-grower used to throw up his hat with joy when he received a dollar a bushel; now he hems and haws when $2.50 is offered for a choice crop.

The Department of Agriculture is now making scientific studies to discover the best varieties of peanuts for particular purposes and to develop the best marketing systems.

The Carnage of Peace

OF the 2,000,000 Americans who went to France to fight, 56,227 were killed or died of their wounds. More than 200,000 were wounded.

In the same period of nineteen months in peaceful America 126,654 men, women, and children were killed, and more than 2,000,000 were so seriously injured by accident that they lost more than a month's time or were permanently disabled.

Where is the man who started the safety first movement?

Air Studies of the Ocean

DR. VOLMAT, a French scientist, recently exhibited in Paris a series of photographs taken from a seaplane, which prove that in order to find out how deep the ocean is, you have but to fly up into the air. Depths can be gaged by studying the photographed tints of the water. Whether the bottom is sandy, muddy, rocky, or granitic is easily determined.

From which this French scientist concludes that aerial photography may be employed as an aid to navigation by revealing the character of the waters that fringe a country's coasts.

Mixing Paint by Air

MOST factories use whole pools of paint. Kept in a tank, paint settles. It must be stirred from time to time, generally by sheer muscular effort.

In one Western factory a resourceful workman hit on the plan of mixing paint by air. The paint was kept in barrels, and in each barrel there was a wooden paddle. By connecting a pneumatic reaming tool with the paddle-shaft and turning on the air, the paint was thoroughly churned up.

Keeping Fruit Fresh a Year

PRESERVING fruits without sugar, alcohol, or heat? It is hard to believe. Yet the food ministry of France announces a process for performing the seemingly impossible.

Professor Gabriel Bertrand is the discoverer. He claims that fruits can be preserved by washing them thoroughly and sealing them hermetically in a jar filled with sterile water.

There must be no air in the jar or the water. Fermentation is sure to set up if air is present. Delicate fruits, such as strawberries and apricots, have been kept for a year by Professor Bertrand.

Bad for Rats

SULPHITE liquor is the bane of the paper-maker. What shall be done with it? Municipalities object to having it turned into streams. It kills fish and pollutes the water. The chemists have been making suggestions about sulphite liquor for years, but it seems to be cheaper to let it run off than to carry them out.

Alcohol is one of the products that can be obtained. More curious is the fact that the liquor contains substances that act as a protection against rats. Added to artificial stone made from marble cement, it produces a product of great strength. Clayey soil is not much good for building, because it does not bind well with lime mortars; but when milk of lime is mixed with the liquor and the loam or clay is stirred in, the result is a material out of which strong bricks can be made.

Gassing the Criminal

A LONE negro, barricaded in a Baltimore cellar, recently held at bay two hundred policemen for three hours. Dr. Robert W. Wood, of Johns Hopkins University, promptly comes forward with the suggestion that tear gas could be used with good effect in such situations.

"Such a gas," he assures us, "could have been projected into the cellar by the simple act of throwing" (presumably in a hand grenade). The man behind the barricade would be temporarily blinded and his shooting aim destroyed. A preliminary dose of sneezing gas would make him reveal his location.

Read Your Own Meter

OUR faith in humanity, somewhat battered after the events of the Peace Conference, has been partially restored by the news that in the far West some of the power companies will let you read your meter, and take your word for it that the reading is truthful.

A post-card is left at your house by the trusting company. You return it with your reading, whereupon you receive a bill, which you pay by check. The practice has been adopted chiefly in the rural districts. The companies maintain that the problem of accounting is simplified, and that there are few complaints of overcharges.

To make absolutely sure that the Muenchausen in us does not assert himself the company sends out a meter-reader in the spring, just at the time of year when the imagination is most riotous.

Why Timber Roofs Rot

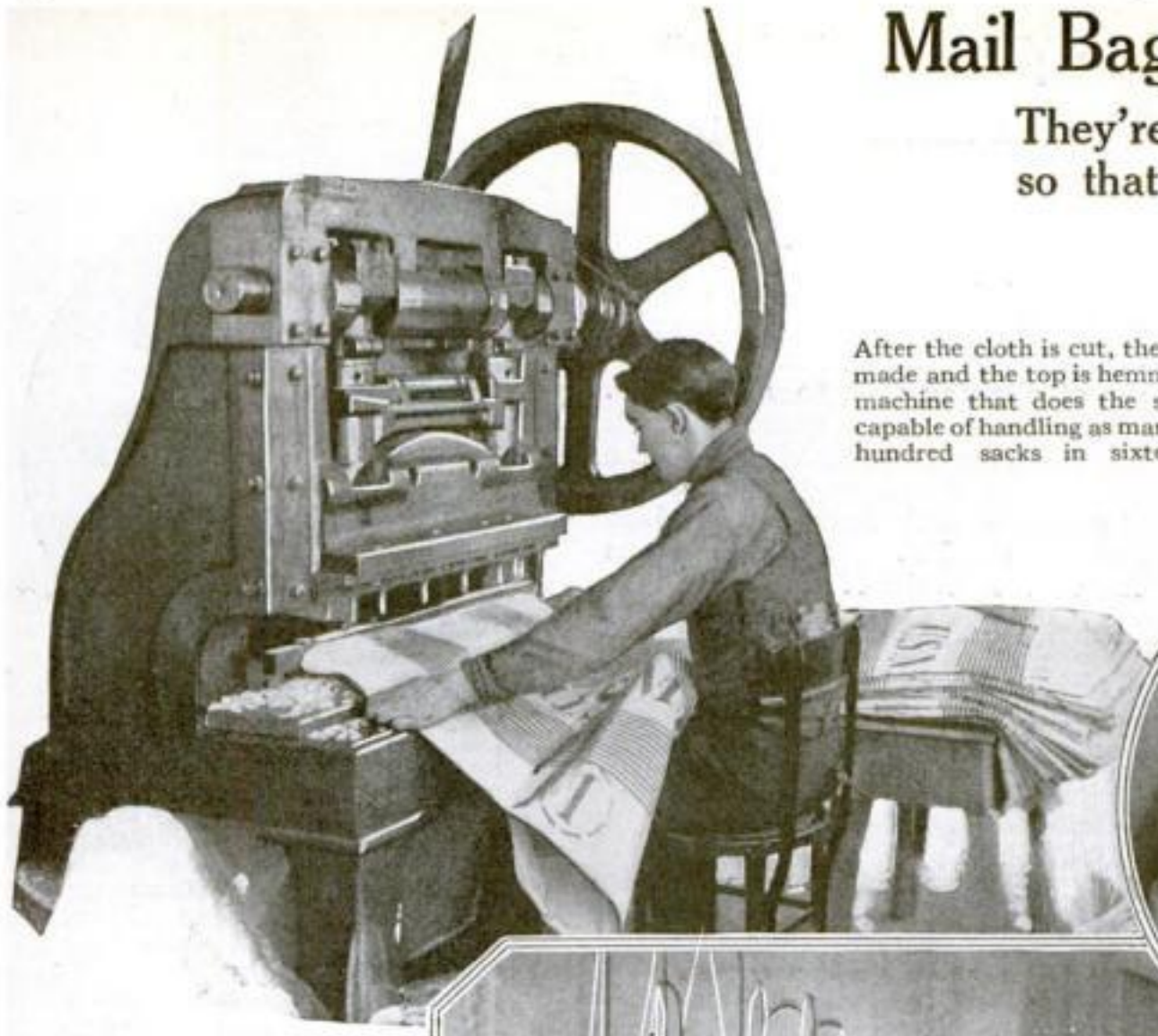
THE timber roofs of weaving-sheds, paper-mills, and finishing works have been rotting away alarmingly. To find out why, F. J. Hoxie, who seems to be an inquiring factory inspector, made a special study that is illuminating. He finds that moist air gives the wood-rotting fungi their chance. Sometimes as much as fifty tons of water is evaporated in a day in a textile-finishing mill.

Mr. Hoxie discovered that wherever the wood is dried by steam-pipes or other means the fungi have no chance, but that where the steam-pipe ends the wood shows signs of decay.

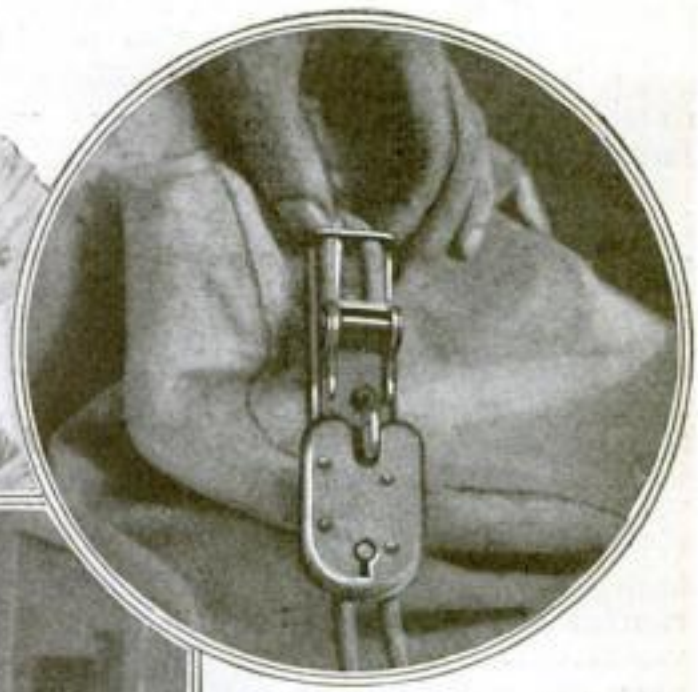
The remedy is obvious. Prevent the escape of the heat, says Mr. Hoxie. Increase the insulation; use steam-pipe covering for drain-pipes and heavy plank for ventilator-openings; stop the moisture from penetrating the roof plank.

Mail Bags in the Making

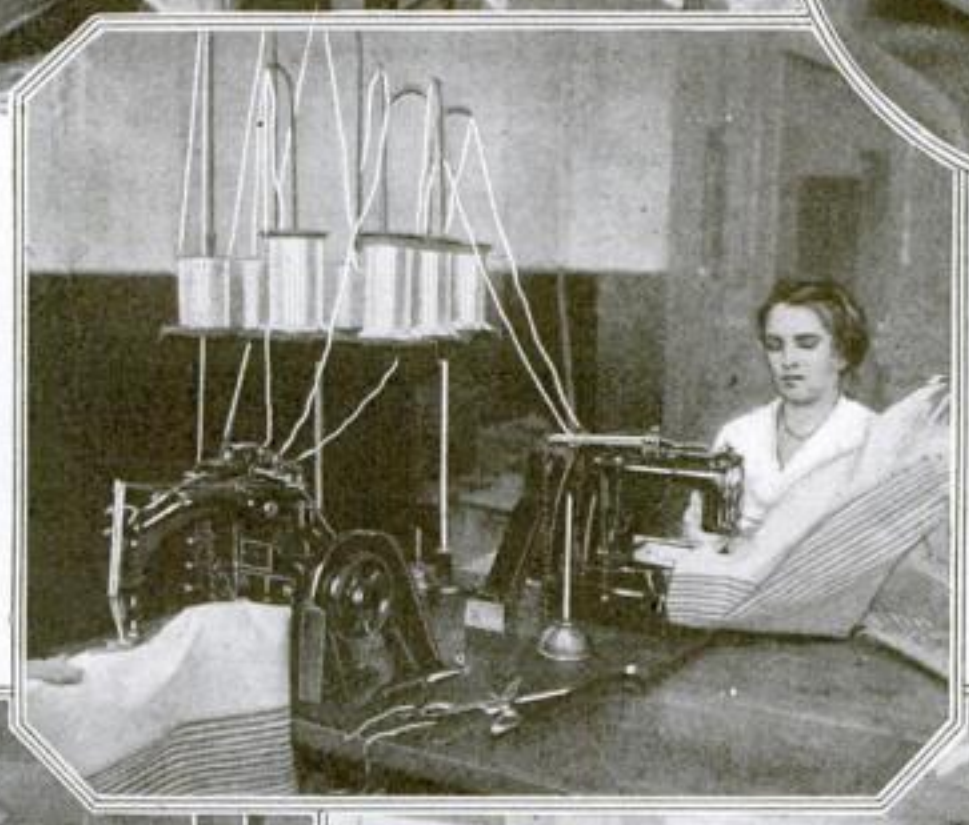
They're fashioned so stoutly so that letters can't escape



After the cloth is cut, the seams are made and the top is hemmed. The machine that does the seaming is capable of handling as many as three hundred sacks in sixteen hours



This is the new lock-cord fastener now used on mail bags. After the lock has been opened, the clasp can be released by slight pressure on what is known as a "dog." This lock-cord fastener was invented by a mechanic in the mail equipment shops where unused bags are kept



Perforations are made in the top of the bag and through them the cord is run. Formerly the holes were made one by one, but now there is a machine that punches a number of bags at one stroke. Thousands a day are punched

Each bag must have its lock. This is the room in which the locks are made. They are carefully tested before being placed on the bags

When a bag is worn out it is sent to the repair shop. If it is not too far gone it is repaired. Condemned bags are ripped apart

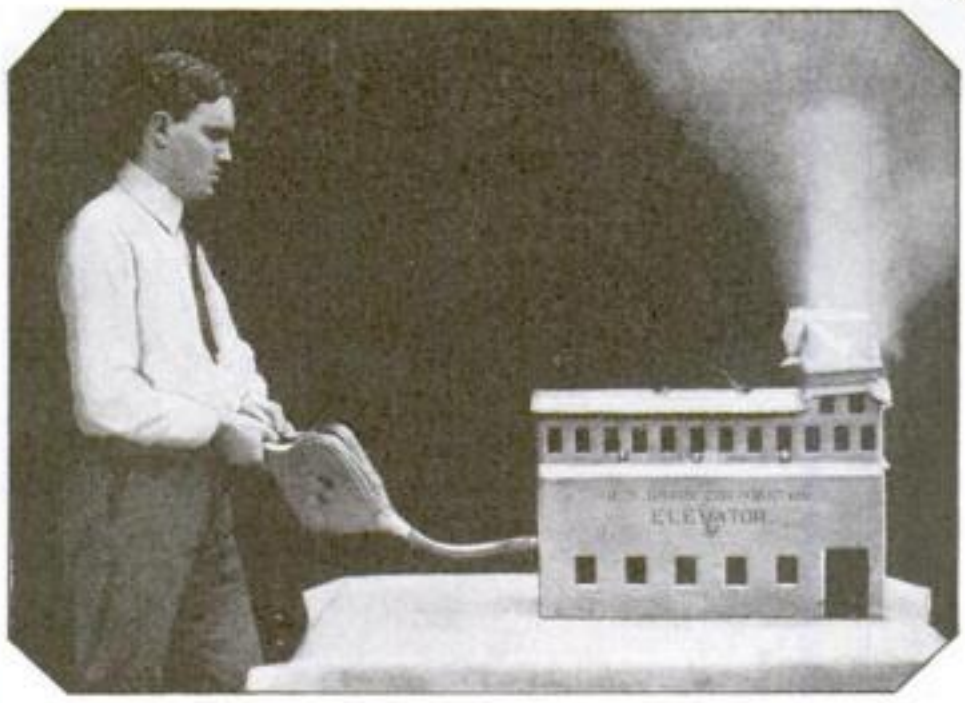
Grain-Dust Explosive? Watch It Flare

IF you do not think that grain-dust is an explosive, or rather a combustible mixture, just come and witness the demonstration given by the United States Department of Agriculture. A miniature and portable grain elevator has been constructed to illustrate how grain-dust explosions can take place in elevators where dust has been allowed to accumulate.

By means of a hand bellows a tablespoonful of dust is blown into the little elevator, in one end of which a small lamp is burning. The dust cloud is ignited by this flame and the finely divided, combustible particles flare up instantly, and with the expansion of heated air the explosion takes place. In the miniature elevator the heavy paper covering over the top where the force of the explosion was started, is blown off. Without this escape valve the elevator would fare somewhat in the manner of the large elevators which have their roofs and walls demolished by the ignition of grain-dust inside. Occasionally in the experiments charges of dust slightly too large have been used, and the galvanized iron miniature has burst. Bolts extending from side to side have been put in to prevent recurrence of such a disaster.

The whole experiment is proving an effective means of teaching the men in the grain-handling plants the danger of allowing dust to accumulate. The extent of damage that may result from dust explosions is shown by the serious explosions which occurred in a period of only four months, here and in Canada. Five explosions caused the deaths of seventy people.

A small galvanized iron grain elevator serves as a model to experiment with combustible mixtures of grain-dust and air. Watch the sheet of paper fastened over the top of the structure

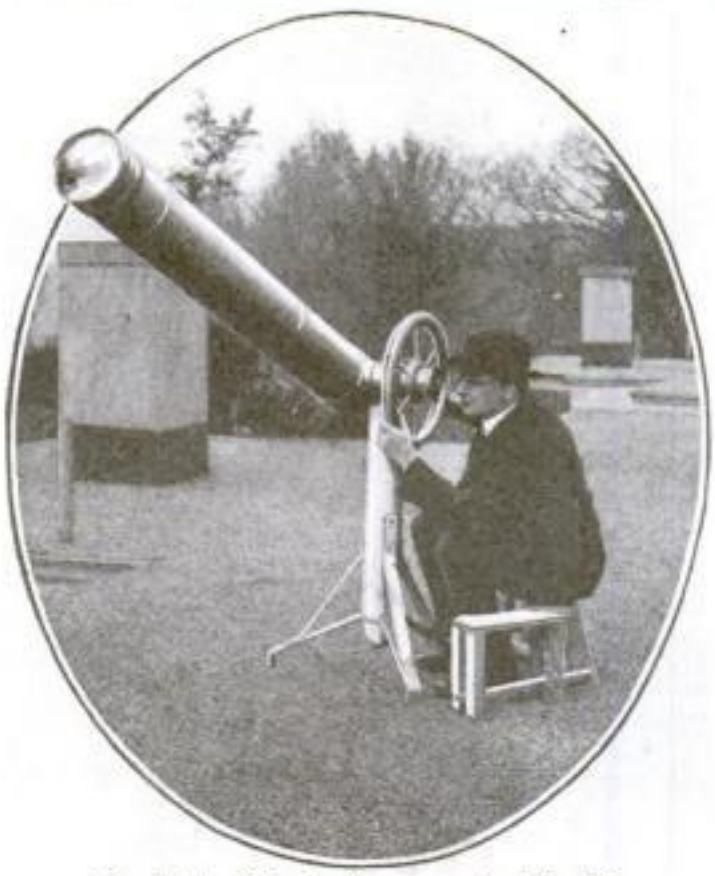


There, she's off! The tablespoonful of grain-dust blown with a pair of bellows into the elevator has been ignited by the lamp, and its particles have flared into flame. The experiment is useful in teaching the men in grain-handling plants the danger of allowing grain-dust to accumulate

This Telescope Is Built to Discover Comets

COMETS appear suddenly out of the obscure depths of the night and the observer who first catches sight of a new comet is quick to telegraph the news and claim the discovery. There are astronomers who on every clear night search the heavens patiently, hoping to add one of these erratic wanderers to their list of discoveries. To attempt this search through an ordinary telescope tires the eyes because of the strained position of the head when using a refractor. Comfort is an important consideration in careful telescopic observation. With tired eyes and a strained neck the observer might not recognize the faint wisp of light which often is all that characterizes a newly arrived visitor.

"Sweeping for comets" is made convenient by a telescope so arranged that the observer can look through the eyepiece without changing the position of his head. As though peeping through a little circular window he sees the starry fields of the sky. A slight motion of the telescope brings other regions into view. The motion can be easily controlled by turning a wheel, much in the manner of guiding an automobile or piloting an airplane. In the trip through the starry depths of night, wandering among stars too faint to be caught with the naked eye, the astronomer glimpses a mere speck of luminosity. He studies it carefully. Then he looks at his catalogue of nebulae to make sure that this is not one of those evasive bodies remote in the distance of space.



Dr. Metcalf looks for comets with this convenient "comet-seeker." He can easily turn it in the direction desired

Not finding it to be a nebula, the observer reads the position angles of the stranger, then he watches it patiently for thirty minutes or several hours. Comets that are remote from the earth do not appear to move very rapidly. The slightest indication of change of position with relation to the nearby stars will at once proclaim the body to be either a comet or an asteroid. If it is decidedly nebulous in appearance, the chances are that it is a comet.

Rev. Joel H. Metcalf, of Winchester, Mass., has devoted much time to the pursuit of astronomy. He has successfully attempted the difficult task of making several refracting telescopes. The 16-inch doublet now used at Harvard College is an example of his skill as an amateur telescope maker. During a vacation at Camp Idlewild, South Hero, Vermont, Dr. Metcalf discovered two comets in one week.

What Is There in Telepathy?

Let us consider the evidence for thought transference

By A. J. Lorraine

YOU do not believe in telepathy? These lines that you are reading —I have written them. You understand their meaning. Then, it seems, I have been successful in transmitting thought from my mind to yours, have I not?

Ah, you say, that is different. Telepathy means direct thought transference, without words actually spoken or written.

But is that so different? You think that words are the essential element in actual, *bona fide* thought communication. Think again. Are words really so fundamental, or is there something else more basic involved? If it really is just a matter of words, then, for example, what thoughts do these words convey to your mind: *"Na varina cudyaty antaralma"?* Gibberish? No; Sanskrit for: "The conscience can not be washed clean with water." You say, "Oh, well, of course, I do not understand Sanskrit."

Very well. Words alone are not sufficient. There must be something else, something more essential: there must be *understanding.* Or, to put it a little differently, your mind must be *attuned* to the language and the thought of the speaker. You must have learned the language, and if the thought is presented in writing, you must also have learned to read. And what is this process of learning but the attuning of your mind to certain stimuli, so that it responds to them as the strings of a musical instrument respond to certain notes?

After all, the only thing that words can do is to create in us a frame of mind more or less closely similar to tha of the speaker or writer who has framed them. As for the question *how* words accomplish this, if you can shed any light on this, you are wiser than most men. And as long as we are in complete ignorance as to *how* words do this, what logical grounds have we for the contention that the same thing cannot be accomplished without words?

Accepting Things on Faith

Perhaps your answer is: "Well, I may not be able to explain transmission by words any more than thought transference without words; but, anyway, I am familiar with the first, and have never observed the latter. When I do, I shall begin to believe it."

Card-guessing experiments do not prove telepathy. The guesser may be unconsciously guided by an involuntary, imperceptible muscular impulse from the person knowing the correct card, whose hand he holds

Have you ever seen the rings of Saturn? If not, do you doubt their existence? No? Then you are relying on the evidence of others. Now listen to the evidence of some who tell us their experiences of thought transference without speech or any of the ordinary channels of communication.

Mrs. Green's Strange Dream

Thought transference may be spontaneous, or it may be experimentally provoked. Spontaneous thought transference is no doubt usually more dramatic; on the other hand, experimental thought transference is more convincing as evidence, since the conditions of manifestation can be accurately controlled.

Examples of spontaneous thought transference are innumerable. Many persons have experienced it in their own lives, and it is safe to say that every adult has heard, on testimony deemed trustworthy, evidence of cases among his near relatives and friends. As an illustration I may quote the following example given by Dr. Joire, Professor at the Psycho-Physiological Institute of France. The account of the occurrence is given in the words of Mrs. Green herself, who experienced it. She writes:

> I saw two respectably dressed women driving a vehicle like a mineral-water cart. Their horse stopped at a pool to drink; but as there was no footing he lost his balance, and in trying to recover he plunged right in. With the shock the two women stood up and shouted for help, and their hats rose off their heads, and as all were going down I turned away crying and saying, "Was there none at all to help them?" Upon which I awoke, and my husband asked me what was the matter. I related the dream to him and he asked me if I knew the women. I said I did not, and that I thought I had never seen either of them.
>
> The following third month I got a letter and a newspaper from my brother in Australia, letting me know the sad trouble which had befallen him in the loss, by drowning, of his daughter and her companion. My niece was born in Australia and I never saw her.

The account of the accident given in the newspaper that accompanied the letter tallied in every detail with the scene of the dream.

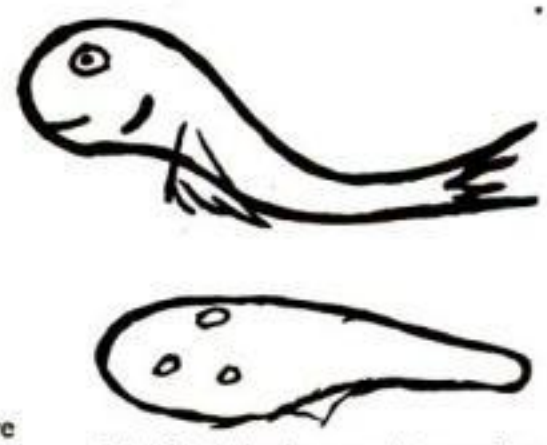
Picking the Right Card

Thought transference of this kind is commonly connected with scenes of distress, and often of sudden death. The conditions for transmitting impressions from one person to another in this way are therefore, as a rule, not within the control of the persons communicating. There are, however, on record, some instances in which a person has deliberately willed to appear to others, and has succeeded in his purpose. A case of this kind is quoted by F. W. H. Myers in his "Phantasms of the Living." The apparition was seen by two persons at the same time, so that the phenomenon would seem to be not wholly subjective.

Of the more definitely experimental controlled thought transference, the

first example that comes to mind—not a good example, as we shall see presently—is that of the well known parlor game of guessing cards and performing similar tricks by "thought transference." A number of cards are laid out on the table. The company selects one card for the experiment. The person who is to guess it is out of the room. He is then brought in (blindfolded, if desired; this makes no difference in the results, though it may be helpful to him in keeping his attention from being distracted). He is placed where his hand can reach the card, and some person acquainted with the choice made by the company takes hold of one of his hands, leaving the other free to pick the card. The agent (the person knowing the card) concentrates his thoughts on the card selected. The percipient (the person who is to pick the card) makes his mind a blank, as far as possible. When he feels that the right moment has come, he puts out his hand and picks up a card. Not all persons are adapted to this trick, but with a suitable pair a considerable number of successes can be scored, although both agent and percipient are quite unconscious of having communicated by any kind of signals.

The straight line and curve are drawn by the agent. The percipient draws a straight line and curve, reversing positions. This is significant, since mediums sometimes write "automatically" in reversed handwriting



Mr. Guthrie drew a picture of a fish. Miss Edwards said, "Are you thinking of the bottom of the sea, with shells and fishes? Is it a snail or a fish?" She then drew the above reproduction for him to see the drawing, presently sketches on another pad the impression received telepathically from the agent. In a considerable number of cases there is found to be a more or less marked resemblance, sometimes practical identity, between the two drawings, as the reader can see for himself in the illustrations reproduced from an actual series of experiments.

At first sight the evidence of such a series of experiments, in which successes sometimes approach to close upon a hundred per cent, seems most convincing. But two human beings have taken part in the experiment, two members of the same biological species. We are all built very much on the same plan. There is the old joke about the

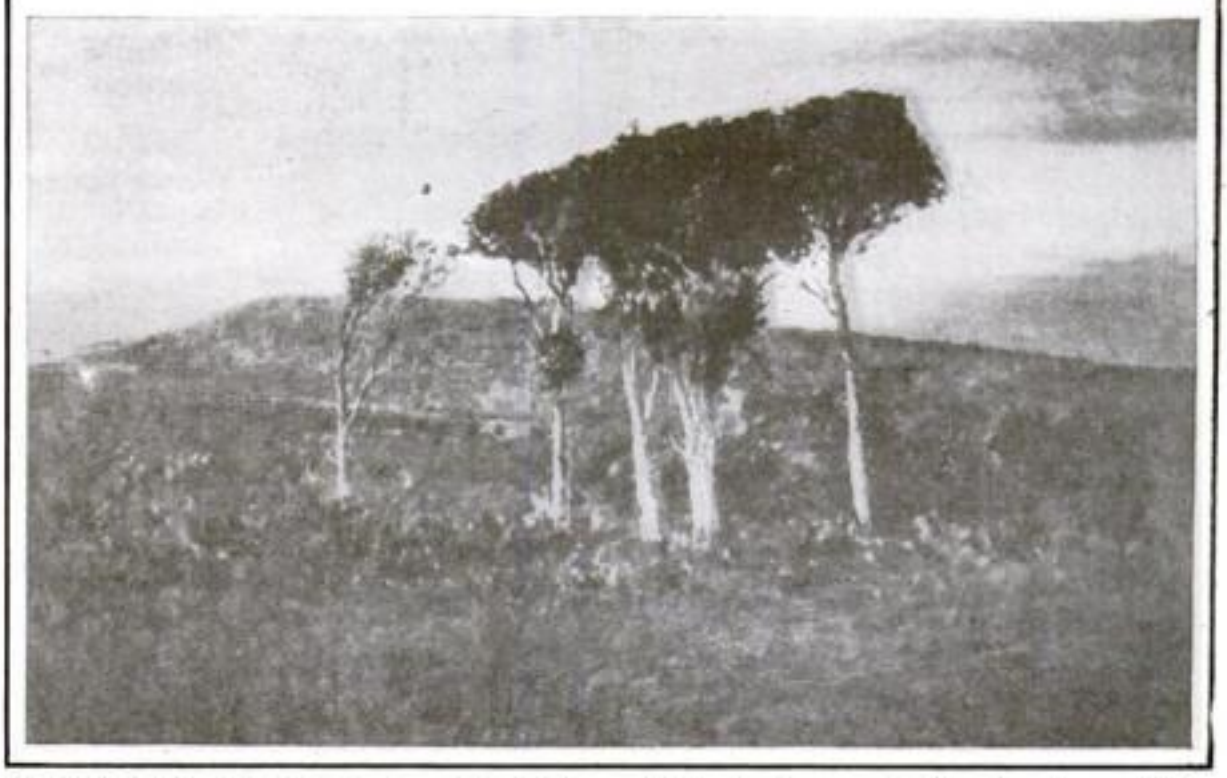
Scientifically Conducted Experiments

Experiments of this kind, in which there is actual contact between agent and percipient, are quite inconclusive, and cannot be regarded as in any way evidential of direct thought transference without intervention of recognized physical agencies. For it has been conclusively shown by psychologists that a person may be guided in his selection by stimuli too slight to rise to his consciousness, but nevertheless capable of influencing his actions. The percipient can thus receive hints from the agent—by involuntary muscular pressure or twitchings of the hand—without either of them being in the least aware of the fact.

But there are many examples on record of thought transference without contact. The stage performances of professionals in this direction we may leave entirely out of account, since it is well known that most, if not all, of these depend on an ingenious code of signals cleverly disguised in the manner of putting the question, "What is this I hold in my hand? The number?" etc. If no words are spoken there is still the possibility of other modes of signaling, of collusion, and of trickery of all kinds.

An entirely different order of evidence comes from experiments conducted along scientific lines by competent and trustworthy persons. Some of the results so obtained are most striking, and, at first sight at any rate, conclusive. So, for example, the agent holds a pad of paper, on which he draws a simple diagram. The percipient, so placed that it is impossible

This is a sketch made by Thompson "when he felt like Gifford," whose work he had never seen. Below is one of Gifford's paintings



Frederick L. Thompson, a goldsmith, followed an impulse to paint. He said he felt like Gifford, a dead painter. Visiting Gifford's former studio he found a painting by Gifford duplicating one of his own. The two pictures are here shown

spiral staircase. Ask anyone who has not already been a victim to this harmless joke: "What is a spiral staircase?" In nine cases out of ten he will motion with his hand, and say: "It is a staircase that winds this way," or words to that effect. Under similar circumstances we all do very much the same thing. So, if two people draw a few simple diagrams at random, the chances are that a good proportion of them will be very similar. It looks like thought transference, but it is merely the similar working of two similarly constructed machines—so the skeptics say. Lieutenant-Colonel Le M. Taylor, however, has shown, to his own satisfaction at any rate, that the successes obtained far outnumber what might be expected on Professor Sedgwick Minot's theory of chance combinations due to similarity in the human make-up.

Chance or Telepathy?

Can coincidences account for strange cases of telepathy? In the case of Mrs. Green's dream of the drowning of her niece, for example, was it purely chance that this should have occurred just at the time of the accident? Improbable to the point of being impossible, you will say. But do not forget that highly improbable things are happening every day. A notable example of this formed the subject of a law-suit some years ago. An English magazine called the *Rocket* had offered a prize of $5,000 to the person who should guess correctly the number of male and female births, and the number of deaths in London during the week ending December 11, 1897. A butcher of the name of John Henry Hall made 252 guesses, including one that turned out to be correct, as follows: Births, male, 1,244; female, 1,245; deaths, 1,866. (Incidentally, he won his suit.) It has been estimated that the chances of making a correct guess in 252, in this case, was one in 1,740,000. Yet the event occurred. Many other examples of equally unlikely things happening are on record.

The agent draws simple sketches. The percipient, who cannot see them, sketches the impressions telepathically received. To the left in the above picture are the agent's original drawings; to the right, those of the percipient

It must, indeed, be admitted that most extraordinary coincidences do happen, and are even comparatively frequent. Naturally, if such a coincidence happens to relate to an event of great personal significance and strong emotional appeal to us, such as the death of a near relative, the occurrence remains indelibly fixed in our memory, while less striking examples, equally common, but without personal appeal, quickly fade from our recollection. This may lead to an impression that there is some causal connection between a dream, or a presentiment, and some event to which it appears to relate; when, in point of fact, there is nothing but a coincidence involved. The volume of evidence of remarkable occurrences of this character that has been collected, however, makes this explanation appear decidedly strained.

The Thompson-Gifford Paintings

Inasmuch as telepathy does not appear to depend on the ordinary physical action of our senses, some investigators of psychic phenomena (among them Sir Oliver Lodge and Dr. Hyslop), have held that it is a mode of communication that opens the door for intercourse between living people and the discarnate spirits of the departed. Of the evidence adduced in support of this thesis, one of the most remarkable instances is the Thompson-Gifford case.

A certain Frederic L. Thompson, a goldsmith, was suddenly and inexplicably seized, one summer, with an impulse to sketch and paint pictures. He was an uneducated man, with no art training. As an engraver he showed, however, a certain native talent for sketching.

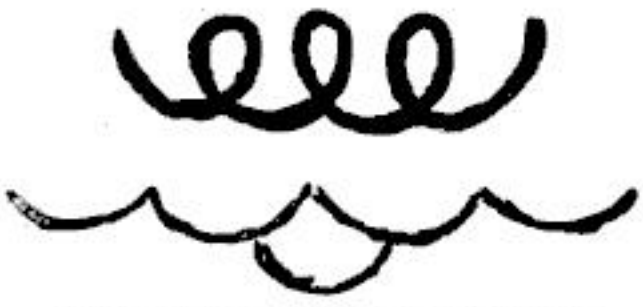
With this impulse to sketch came a disinclination, a nausea for his regular work, which ultimately rose to such a pitch that he became unfitted to attend to his business. He had had a very casual acquaintance—two or three meetings and only a few words spoken—with Robert Swain Gifford, the artist, some years before. Now, there were strange things about Thompson's painting. He used to say that when he was sketching he felt that he was Gifford. He would remark to his wife, "Gifford wants to sketch." In point of fact, Gifford had died about six months before, though Thompson was unaware of this.

Dead Artist's Work Duplicated

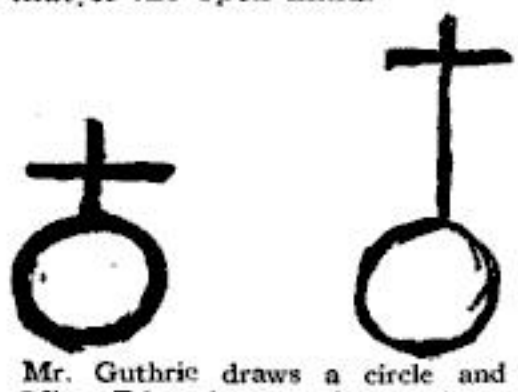
Meanwhile Thompson was recording on canvas the visions of landscapes that haunted him. In July, 1907, having meanwhile heard of the death of Gifford, he decided to visit the home of the artist and the scenes of his activities. Judge of his consternation when, on entering the abandoned studio, he found himself face to face with a painting by Gifford, practically a copy of one of his own sketches! As this sketch had been placed in the hands of Dr. Hyslop in New York, these extraordinary facts are established on incontrovertible evidence.

There was other evidence of the same character, all pointing in the same direction, that Thompson's activity was directed by another personality, that of the deceased artist, Gifford.

What are we to think of these strange reports that come to us from persons of high repute? It is hard to say. The correct attitude seems to be that of the open mind.



Miss Birchall drew a corkscrew curve. Miss Ralph looked at them and said she seemed to see a lot of moving rings



Mr. Guthrie draws a circle and Miss Edwards reproduces them. She cannot see or touch Mr. Guthrie

Clamping Down Cloth

THE old method of holding a number of layers of cloth to be cut was to put heavy iron weights upon them. There is now an invention that not only holds the cloth firmly but also counts the layers.

A metal base is clamped to the cutting table, and upright brackets on each end carry each an arm which holds a connecting rod and a blade to which are attached plungers that firmly hold the cloth. An automatic counter is attached to the bracket platform.

The clamp is screwed to the table and the counter is set at zero before using it.

Use a Vacuum Cleaner

DID you ever try to clean a typewriter? You get along beautifully as you dust off the top, but when you try to go beneath the surface your troubles begin. Your brush, be it long and thin or short and fat, won't reach all the hidden corners.

A vacuum cleaner will help you out. It will suck up all the dust and bits of paper that cling so persistently. The best attachment to use for this purpose is the thin flat one known as the mattress attachment.

Poor Butterfly!

THE bards do sing of poor Butterfly, the Japanese maiden, but none of them think of singing about the poor butterflies above. Their lives were sacrificed just to decorate some fair lady's serving tray.

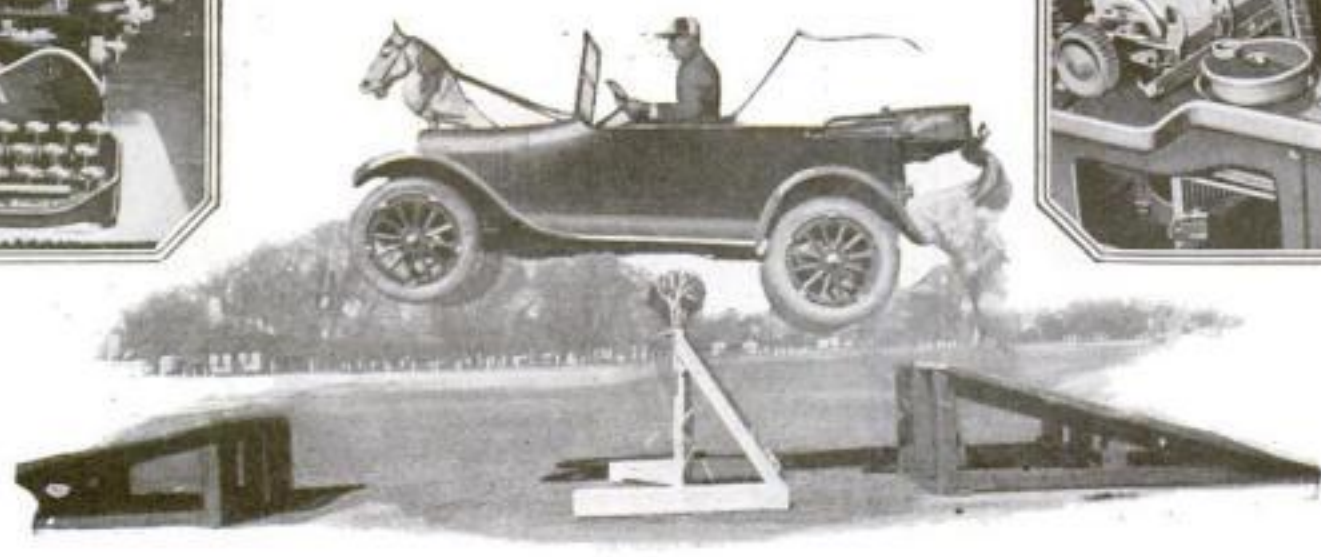
The butterfly wings are placed under the glass top and are practically airtight. But should the tray receive rough treatment, the wings would crumble and the entire effect be ruined. Insect decoration becomes more and more popular. Recently a German made a crown of bugs.

A Gasoline Broncho

IN a horse and stock show held in Denver, Col., an automobile was used as an added attraction in the hurdle-jumping contests. Much to the surprise of the horsemen, it showed extraordinary jumping powers. With the greatest ease the car leaped eighteen feet through the air, clearing the five-foot hurdle like a bird.

To add to the effect, a *papier mache* horse's head was attached to the front of the car and a long rope tail at the back of the machine, while the driver of the automobile was attired in jockey's uniform of racing silks and cap.

The feat was repeated several times during the show.



A Mastodon Souvenir

THE ancestor of the elephant, the mastodon, ages ago roamed wild through the forests of Kentucky; it is certain that he did, for once in a while his bones are dug up. The latest and largest "find" is a huge tusk of solid ivory, a fossil, weighing 156 pounds and 9 ounces.

It is 6 feet 10 inches long and was unearthed by a steam shovel at Ludlow, at a depth of 35 feet, in a gravel bank. A foot or more is missing from the thick end of the relic and probably 9 inches are lost from the small end, but the tusk is no small souvenir of "elephant-days" in old Kentucky.

New Typewriter Clamps

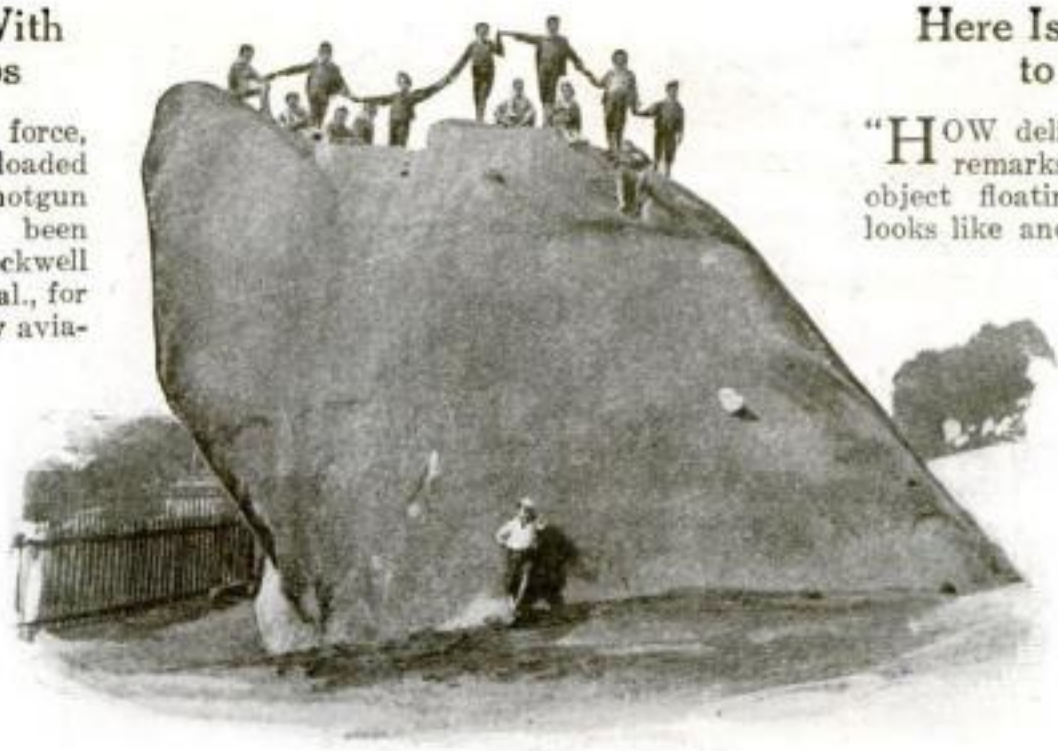
THE typewriter below looks like an ordinary typewriter, but it isn't. It is equipped with vastly improved paper clamps "which are mounted slidably with relation to the scale bars at the side front of the platen"—so the patent paper tells us.

In other and more simple words, the clamps that hold the paper down are made so that they may be pulled back from the paper and automatically locked in place when the typist wishes to correct an error.

Training Aviators With Terra Cotta Bombs

BOMBS of low explosive force, made of terra cotta, and loaded with black powder and shotgun ammunition, have recently been brought into service at Rockwell Aviation Field, San Diego, Cal., for training United States military aviators.

These practice bombs have little destructive force. They are loaded with just enough explosive to burst upon striking the ground, producing a dense column of smoke that enables aviators flying as high as 20,000 feet to observe their contact.



Here Is Still Another Way to Fool the Fish

"HOW delicious that looks!" Mr. Fish remarks when he sees an attractive object floating by. Indeed, it almost looks like another fish, one just the right size for a good meal. So Mr. Fish makes a lively leap toward his victim. He takes a big gulp, and lo! he is caught upon the metal hook that dangles below the colored body of the "fish."

This artificial bait has two revolving propellers. As the line drags it on the water these little wheels turn, and give the object a semblance of life.

Sliding Down the Neck of Dog's Head Rock

SNOW is unknown in western Australia, but the boys of Albany, a seaport on the southern end of Australia's most westerly state, have in their town a slide and natural curiosity combined which helps make up for the lack. It is a huge rock, called Dog's Head from its remarkable resemblance to the head of a great mastiff. The height of the head is about twenty feet, and the length of the head from the tip of the nose to the base of the neck is thirty feet. It is the neck that the Albany youngsters use as a slide.

The rock shows signs of having been worn away by water action in earlier geologic periods, and later erosions completed the work. In the picture the boy's cap has fallen into the right spot to give a realistic appearance of an eye.

Bidding by Push-Buttons at Auctions

THE bustle and noise attending an auction do not meet the approval of the easy-going Dutchman, so in Holland there is a quiet electrical method of conducting auctions. Every bidder receives a number, and must take a seat marked with the same number. On the stand of the auctioneer is a dial with a pointer indicating prices of the sale. The tablet bears as many numbers as there are seats in the hall, and each number is electrically connected with the seat carrying the corresponding number.

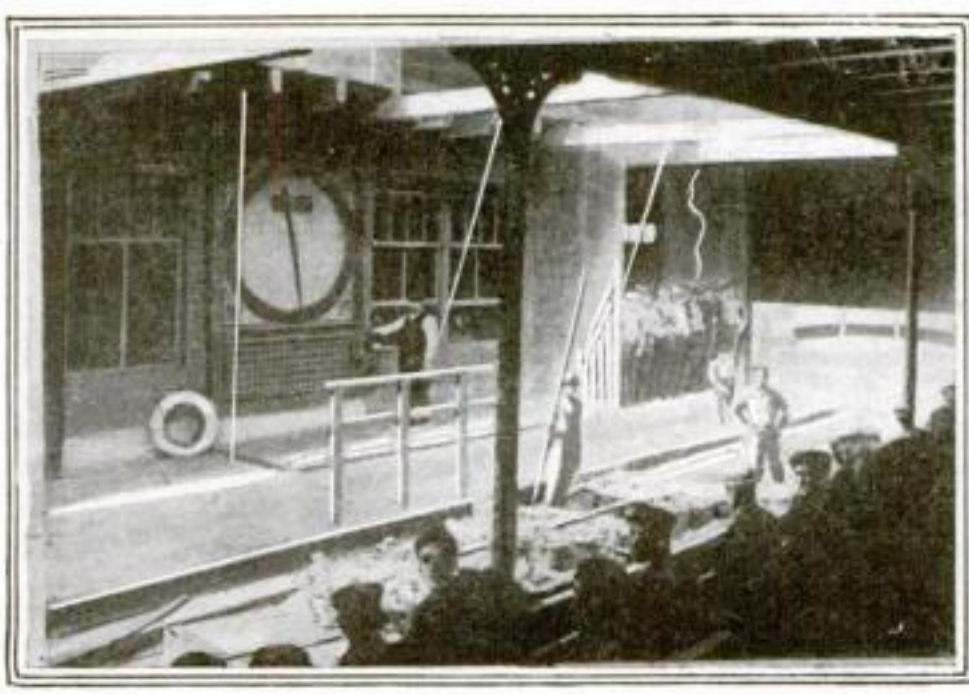
When the prospective purchaser sees a price to his liking on the dial, he presses a button on his chair and the pointer stops.

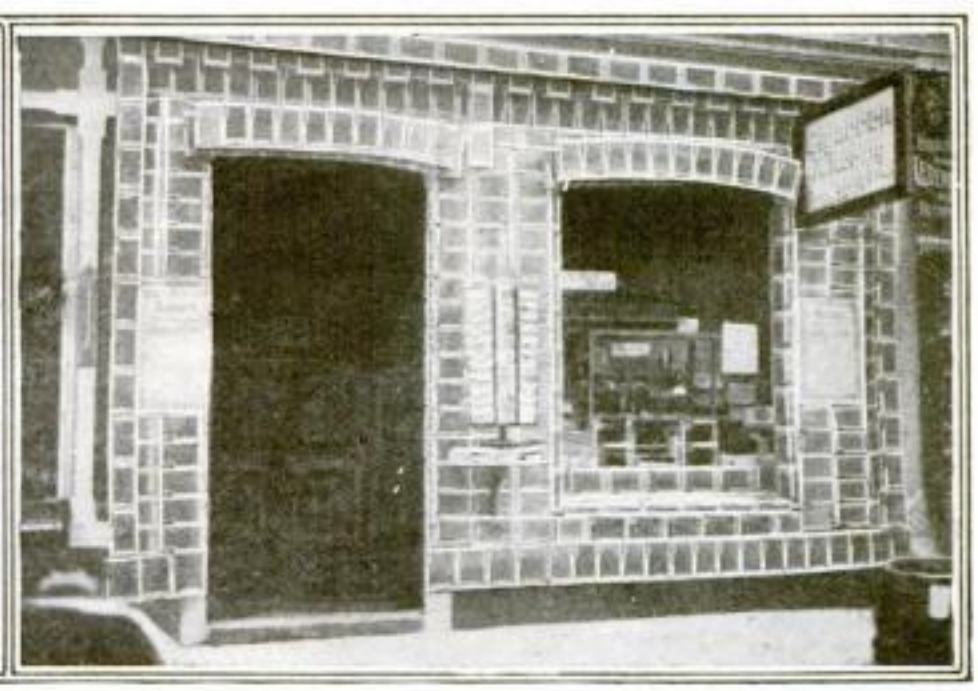
It Pays to Advertise—Proved Again

ANYONE who doubts the value of advertising, take heed! A German who owned a cigar store found business very dull; whereupon he covered the entire front of his store with cigar-boxes. Immediately his business increased enormously.

He had to hire extra help in order to handle the crowd. Hardly a cigar smoker in town could resist the appeal of the empty boxes; that town, by the way, was Bremen.

Recently the owner of a drug store filled his show-case with powder-puffs because he had too many in stock: there were several new powder-puffs in action that night. It proves again the power of suggestion and how it pays to advertise.





Its Edges All Curve

A NEW type of violin has been invented which has only rounded or curved edges. While generally conforming to the dimensions of an ordinary instrument, the novel violin is made so that the top and bottom come into direct contact by a curve at the sides. It is claimed that this greatly improves the tonal quality and renders the instrument stronger than it would be if straight sides were used.

The chin-rest for the curved body has to be specially arranged, and the clever combination of a chin-rest and tail-piece is the result. Mr. John T. Anderson, of North Carolina, is the inventor.

This Bank Lends Radium

RADIUM is very precious, since it is both scarce and expensive. Yet it is greatly needed in hospitals for the treatment of cancer and similar diseases.

There has recently been established a radium bank, which will be conducted just as if it were a regular bank. Radium is deposited in it, and lent to doctors or hospitals at a regular rate. The first deposit of radium is shown in the picture. It is valued at five hundred thousand dollars.

Hospitals that heretofore were unable to buy radium will now be able to borrow it. The new source of supply will make its use more general.

© Keystone View Co.

Short Telephone Booths

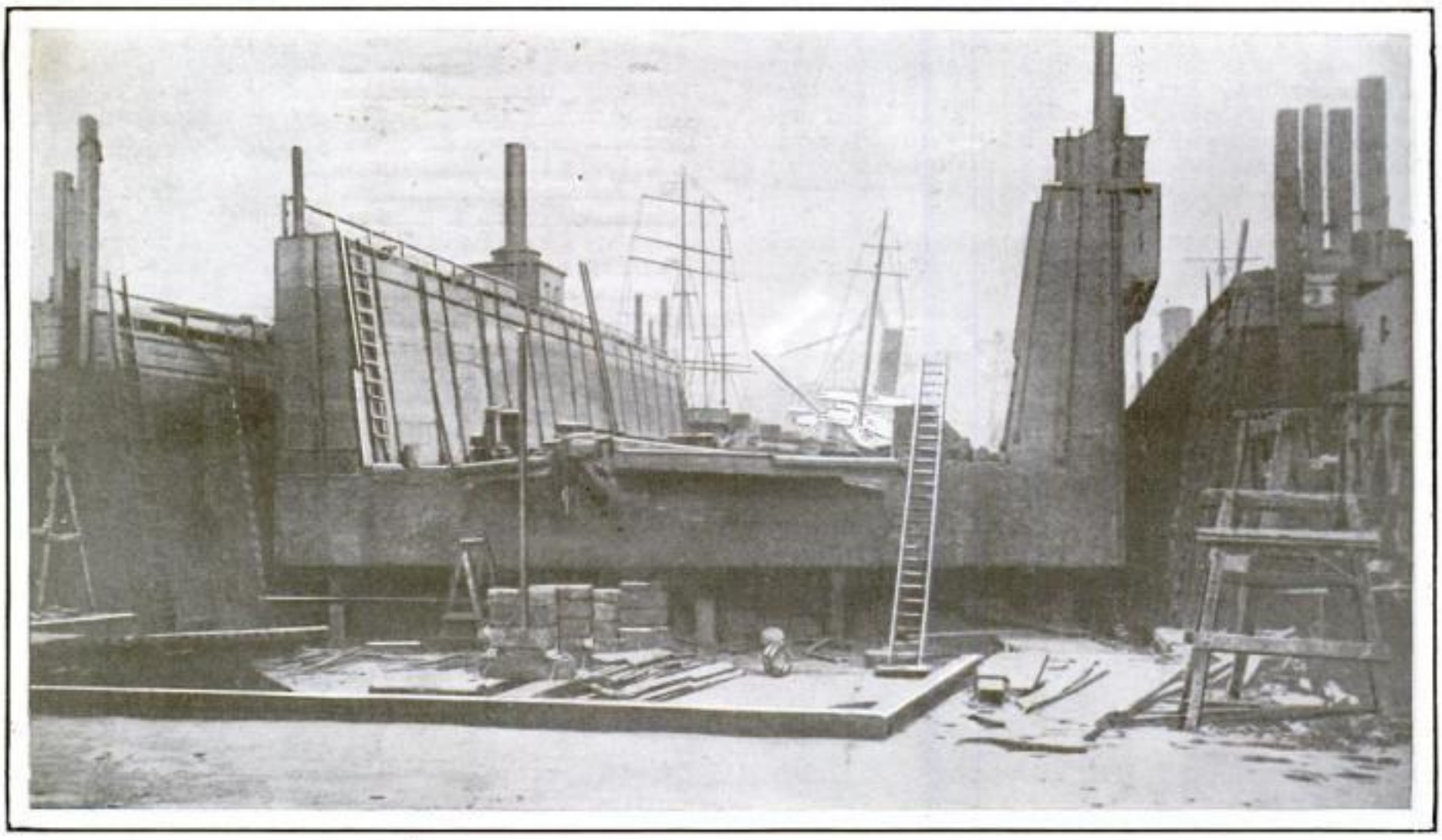
EVERY time you telephone from a booth you feel sorry for Aida, who suffocated so nobly with her lover.

But there has been invented a booth in which you do not suffocate; neither do your words get out. The booth reaches just below your waistline. You pull a cord and the booth enfolds you.

When the Drydock "Goes to Drydock"

A DRYDOCK'S life is nothing but one repair after another. It is always taking in crippled ships and making them whole again. After years of this sort of work, the drydock is all worn out and needs repair itself. Then it visits another, larger drydock, and for a while receives the care and attention it had always given to others. Below you see just such a drydock. It was located at Hoboken during the war and did its bit nobly.

But when the war ended, it was badly in need of repair. It was towed down the river and is visiting a brother drydock.



Now the pendulum is swinging back. From no wires at all, Major-General Squier is leading engineers to the use of a single bare wire between stations as a guide for the radio waves. Along this wire he proposes to guide, not a single message, but simultaneously as many as forty different messages. Multiplex guided wireless is the next swing of the pendulum.

But the General doesn't care whether the uninsulated wire is above ground or below, or even under water. Hence his method is applicable to trans-oceanic communication—not only telegraph, but telephone. He has tried it out over short distances, between Fort Washington in Maryland and Fort Hunt in Virginia, and also at one of the Signal Corps stations in New Jersey.

Wireless Messages by Wire

Major-General George O. Squier, of the United States Signal Corps, sees no hope in developing cables and telegraph lines. Only one message can be sent each way at a time over a submarine cable, and the insulation costs from $1,500 to $2,000 a mile. He has invented a system combining wireless with telegraphy and cabling. In this article we tell you how he would use bare wires to send wireless messages—forty of them at once over a single line.—EDITOR.

It looks like a marvel that one wire can guide forty different telephone conversations without their mutual and destructive interference. To the radio engineer, however, this part of his scheme is commonplace.

In ordinary land-line telephony the transmitter varies a current that comes from a battery, and that would otherwise be perfectly steady. It makes this current increase or decrease in response to the motion of the diaphragm of the transmitter, and hence causes similar variations in the receiver diaphragm. But in radio the current that the transmitter diaphragm varies, that is, modulates in accordance with the voice, is not a steady current at all. It is a specially generated current, which increases and decreases alternately, but at an enormously high rate, thousands and in some cases even a million times a second. Such an alternating current varies too rapidly to affect the receiver diaphragm, and, even if it did, it wouldn't make an audible sound because the human ear can't detect sounds from drums that are vibrating faster than twenty or thirty thousand times a second.

How "Wired Wireless" Works

What counts, in the case of such a high-frequency alternating current, is the "effective value," as it is called; that is, the amount of steady current that would produce the same heating effect. Electric heaters, lamps, and the like work just as well in an office building having a direct or steady current supply as in a village house where the current is alternating. The thing that counts is the effective value of the current, and not its alternations. In the same way, the rapidly alternating current of radio practice is just as good for being modulated by the voice as is the steady current of early wire telephony.

There are also many different devices—or radio detectors, as they are called—that, like electric heaters, respond, not to the rapid alternations in the current, but only to relatively slow changes in its effective value.

The vacuum valve (a kind of electric lamp) is the most justly famous of all the detectors, and is the ultimate prize of every junior wireless amateur, whose pocket-book compels him to use the less efficient and older style "crystal detector," which consists of a metal point resting on a galena crystal. Such a crystal device will pass current most efficiently only in one direction and practically not at all in the other direction. What flows across the contact points, then, from a source of high-frequency current, is merely a one-way current. Any changes in the intensity of the high-frequency current will mean corresponding changes in the intensity of the direct or one-way current, that gets through the detector. It is this one-way current that is used to operate the receiver, just as in ordinary telephony.

Such high-frequency currents have one enormous advantage over a direct current to carry the telephone message. This advantage lies in the fact that each high-frequency current may be separated from all the rest by applying a principle known in the art as "resonance." Just as the trained orchestra leader can attune his ear to any instrument of his orchestra, and apparently be oblivious to all other notes, so a radio-receiving set may be made selectively sensitive to only one of many high-frequency currents. Just as we distinguish notes of musical instruments by their pitch,—that is, by the number of vibrations a second that the instrument sets up in the air about it,—so the "tuned circuits" of radio-receiving apparatus distinguish between different "pitches" or frequencies of ether waves.

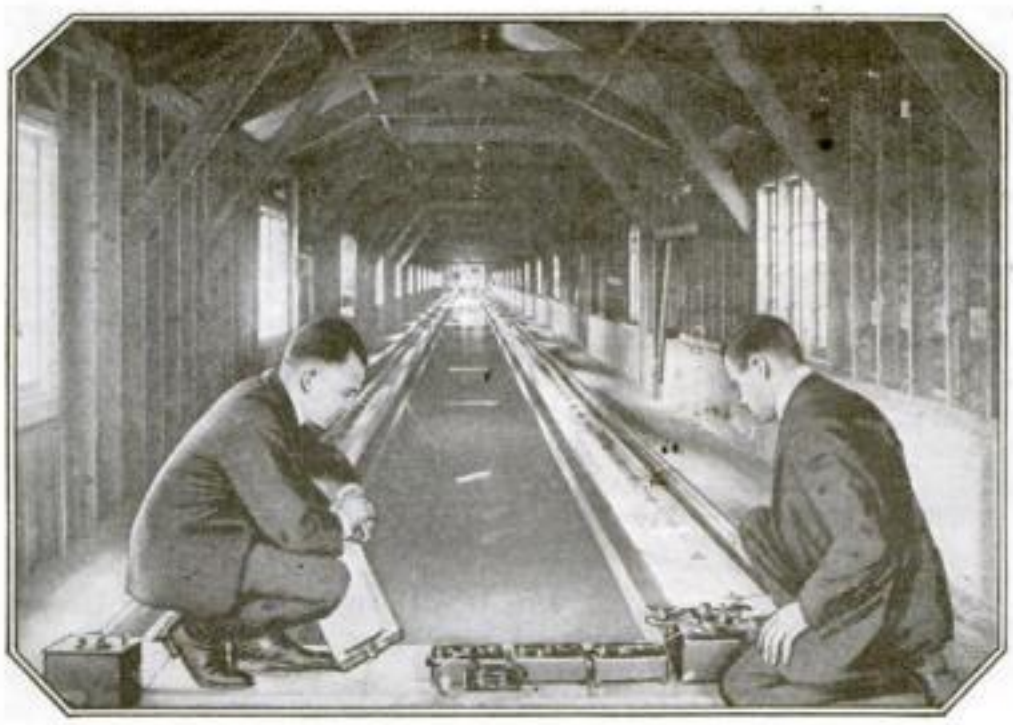
Sending Many Messages Along a Single Wire

Over the same wire or through the same ether we may send many different currents with their different frequencies of alternation, and have each selected and received only by its own receiving circuit. Each of these high frequencies may be used to carry a telephone message. A multiplicity of messages is thus sent through the ether without confusion. Of course, where two or more sending stations try to use the same high frequency to carry their individual messages, there will be interference.

General Squier put the case before the National Academy of Science recently as follows:

"In ocean telegraphy the elaborateness of line construction has reached a practical limit. The most promising hope of improving ocean cables is to abandon the present method and to start with the bare wires in water, using high-frequency current."

If that dream is realized, before long we may be able to say to some international "central:" "Give me Paris, East 238,375."



This is a tank in one of the buildings of the Bureau of Standards. General Squier laid bare wires in the water and showed experimentally that it was possible to send wireless messages along the wire under the water. Forty can be sent at one time

Everything to Make Housekeeping Easy

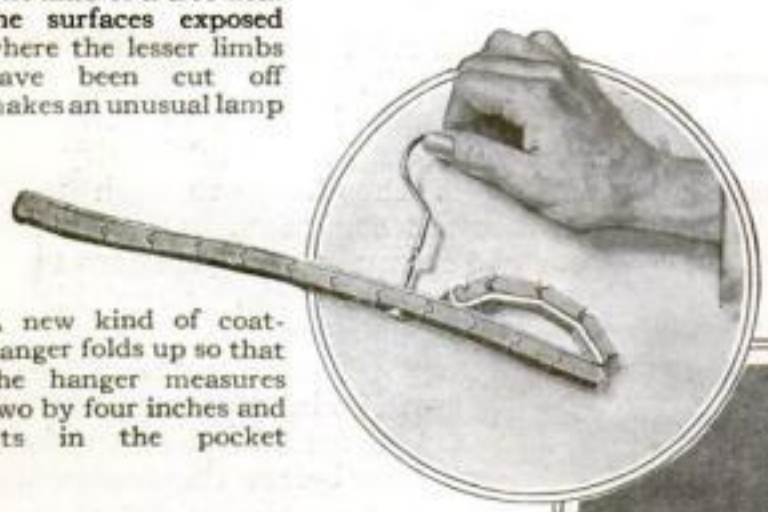
Did you know that an old tin funnel will make an excellent twine-holder? The twine runs down through the tube

Three times a day the year round the housewife has dishes to wash. Why not install an electric dishwasher? You will eliminate red hands and all the other disagreeable things connected with the drudgery of dish-washing

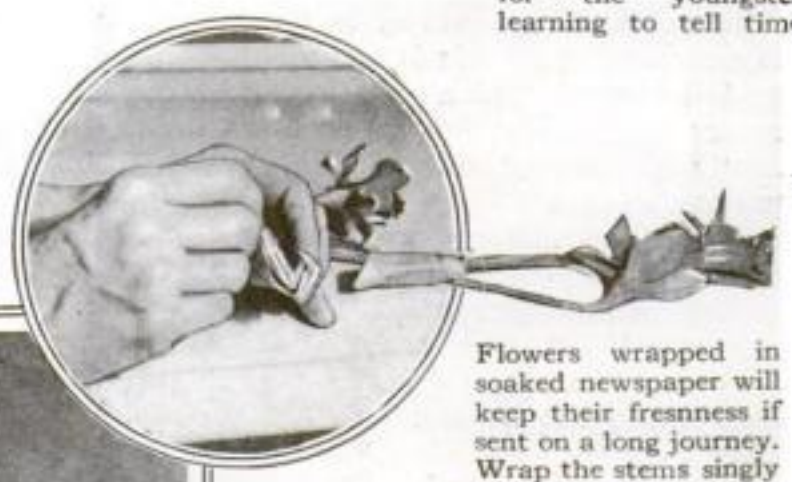
In this combination telephone and lamp the ugly mouth-piece is hidden by a flower-decked lamp-shade

The limb of a tree with the surfaces exposed where the lesser limbs have been cut off makes an unusual lamp

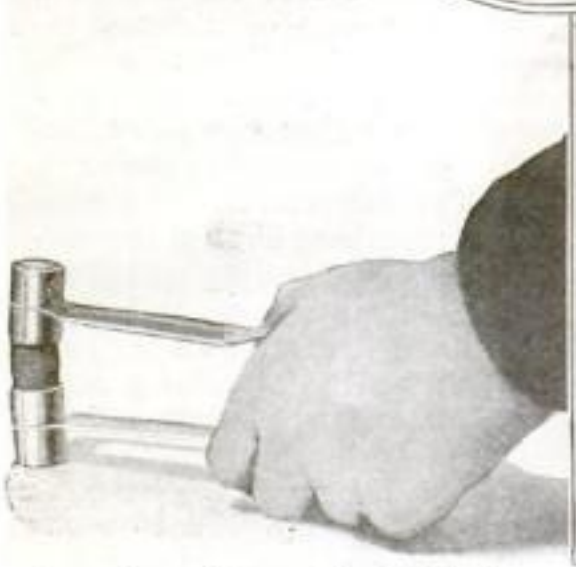
This clock is intended for the baby's room. It is painted in colors for the youngster learning to tell time



A new kind of coat-hanger folds up so that the hanger measures two by four inches and fits in the pocket



Flowers wrapped in soaked newspaper will keep their fresnness if sent on a long journey. Wrap the stems singly

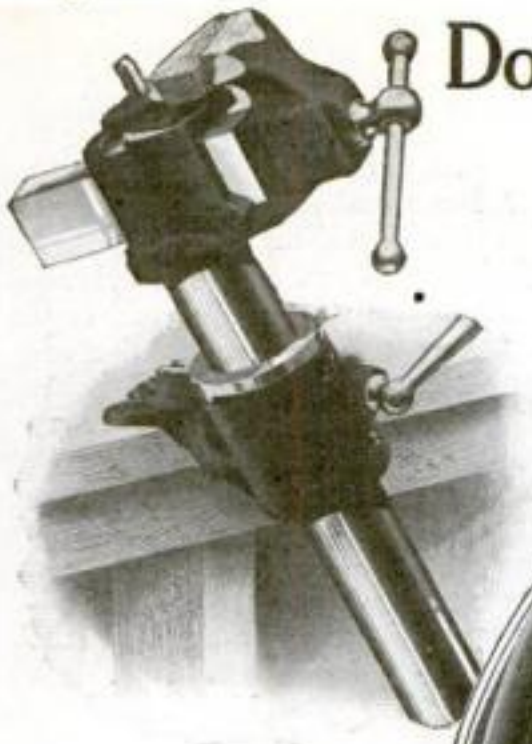


A nut is put between the two lead containers and a sharp rap is given the nut-cracker. The kernel comes out intact

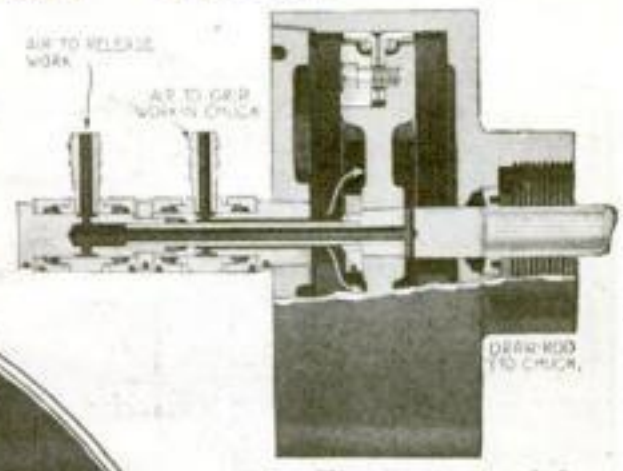
This mixer for the housewife is twirled between the two hands. It is free from all metal parts to injure the contents

Parcels may be fastened securely, and yet be readily opened and closed again, with this simple but effective sealer

Do That Hard Work with Tools and Machines



With this new vise the work-bench mechanic can increase his output, because the vise is mounted on a swivel that enables him to turn the work to the most convenient position

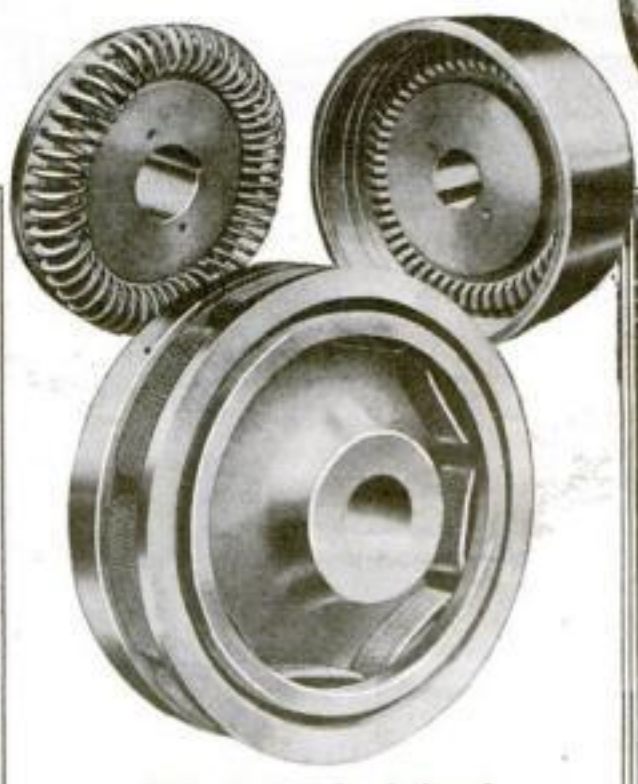


The air-operated three-jaw combination chuck is designed to combine maximum power with minimum weight and simplicity of operation. It is serviceable for severe duty. The coupling is being widely used in rolling mill installations where conditions are always hard

In cutting several thirty-six-inch shafts, it was necessary to cut through twenty-six-inch solid steel. The illustration shows how a cutting equipment accomplished this

A new transveyor truck slips under the heaviest loads and trundles them away with ease. The brake attachment is intended to ease the load down inclines and keep the truck always well under control

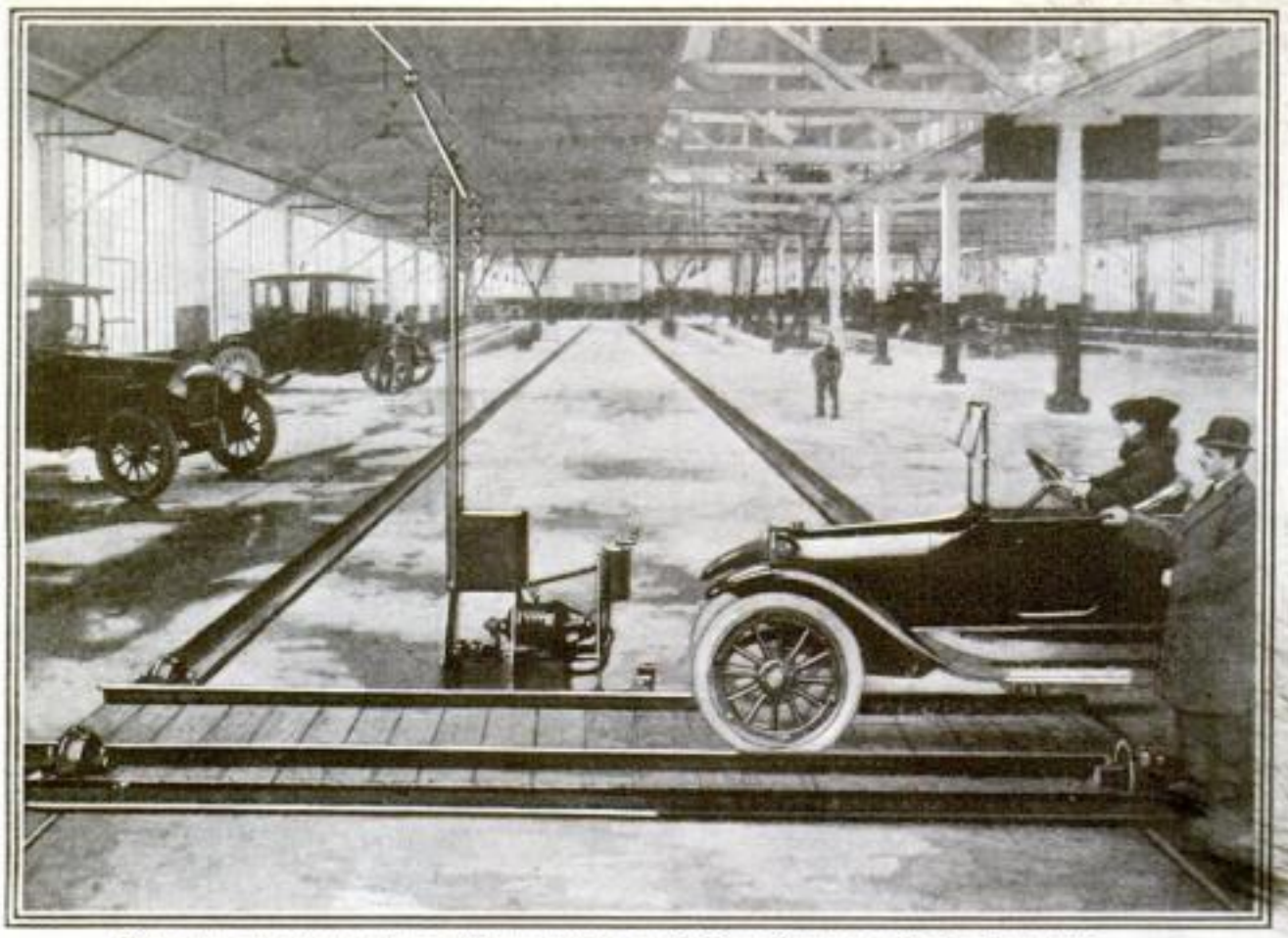
The illustration shows how one man can easily handle a 750-pound barrel. The handler is used for tipping barrels to as well as from an upright position with very little effort



This device is designed for severe service in continuous or reverse drives. The coupling consists of two toothed disks, one being keyed to each of the shafts to be connected

The chute releases on coal gondolas are hard to operate. Here is a new car-wrench that releases automatically

The polishing wheel is first coated with glue, then placed in an arbor, and rolled in the emery-trough

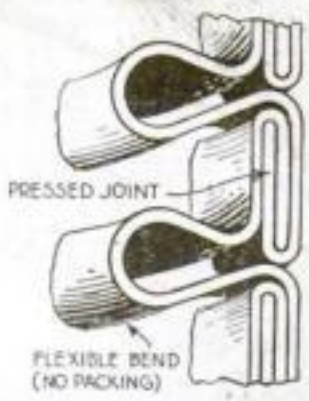


Run the car upon the platform truck, and it is quickly carried to its stall

The Latest Idea in Flexible Metal Tubing

THE considerable use of both large and small sizes of flexible metal tubing for carrying oil, fuel and hot air on airplanes has resulted in an improved type which is now coming into more general use on passenger cars and motor trucks. In ordinary tubing, the flexibility is secured through the sliding action of one strip of metal on that next to it. Provision against leakage when the metal wears slightly is secured by inserting a strip of soft packing between the two, but this, too, wears and results in the tubing losing its gas or water tightness.

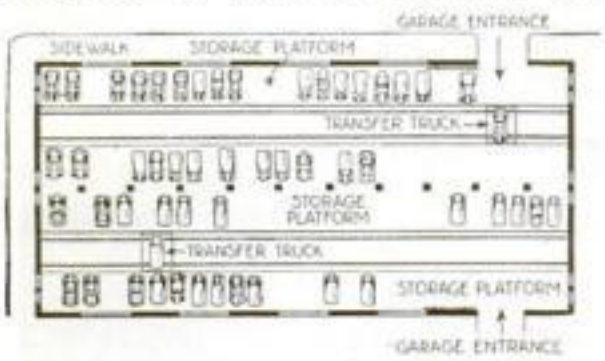
In the new type of tubing, the flexibility is obtained entirely through the give of the metal itself instead of at the seam or joint.



The joints in the tubing are made water- and gas-tight by being set under high-pressure machines. This kind of tubing affords very great flexibility

Garaging Cars Without Damage

MORE dented fenders and more scratched bodies, besides lost time and temper, are caused by attempting to back automobiles into their stalls in public garages than in other service done in such garages. This is caused by the fact that the storage space is so valuable in even the smallest garage in our large cities, that every inch of floor space must be utilized.



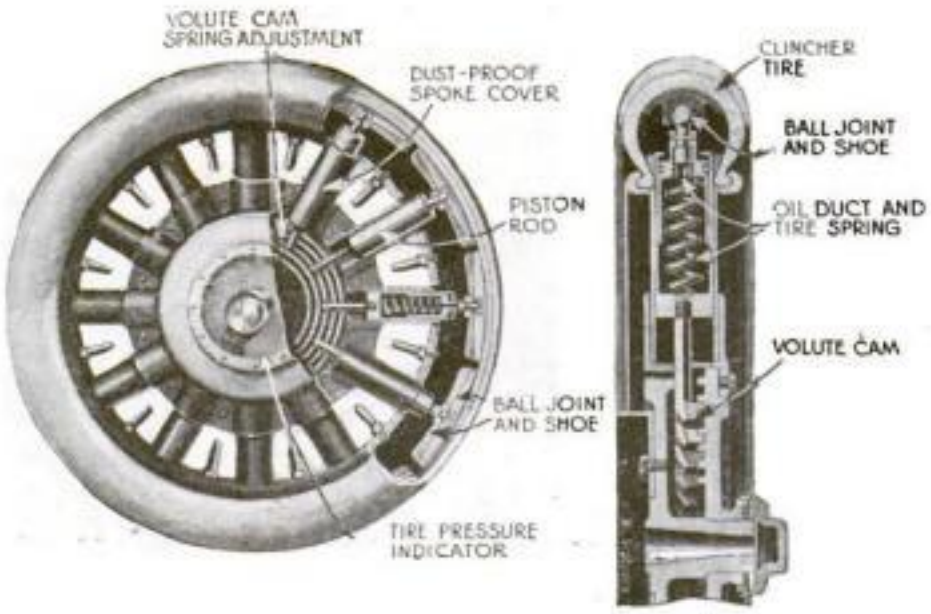
The diagram shows the transfer truck tracks between the rows of cars

One Allentown, Pa., garageman has solved the problem and in a simple manner, by means of two transfer trucks, each running the entire length of the building. Car storage space is provided between each of the tracks and the walls of the building and for a third row of cars between the tracks themselves.

An Airless Automobile Tire that Will Not Puncture

THERE is no question about the easy riding qualities of the pneumatic tire for all sorts of vehicles. Unfortunately, pneumatic tire casings blow out and inner tubes puncture. Inventors have been working since the inception of the pneumatic tire to produce a type of tire or wheel which would give the same degree of ease in riding as the pneumatic but have none of its puncture or blow-out drawbacks. There seems to be no end to the attempts made to devise one, but J. Oscar Smith, of Moberly, Missouri, inventor of the combined tire and wheel shown in the illustration, has made use of new principles.

The wheel is driven in the normal manner from any type of axle. Rigid tubular spokes extend from the wheel hub to the rim which is made to fit a clincher tire casing. Extension members in the tubular spokes hold the casing extended under spring pressure as shown in the cross-sectional view. The inventor claims that the spring support of the casing will cushion the vehicle and load as effectively as an air-filled inner tube; that the casing will last longer than with the ordinary tire and that punctures are made a thing of the past. The last claim is undoubtedly true, since there is no inner tube to puncture and no compressed air to escape. The other claims are open to argument and the wise tire user will consider with the ease of riding, the relative cost of the tire and wheel, its weight and cost of upkeep and repair.



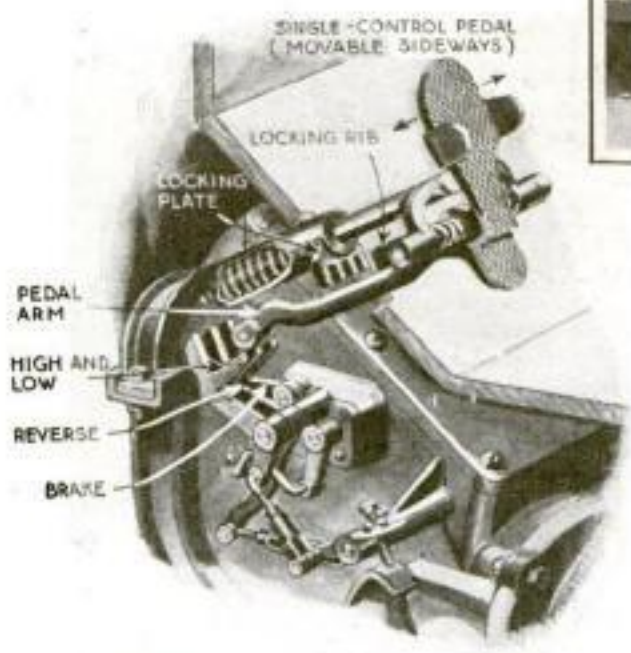
This combined metal tire and wheel does away with tire punctures. Metal springs give ease of riding similar to that of air-filled tires

Change the Speed with Your Foot

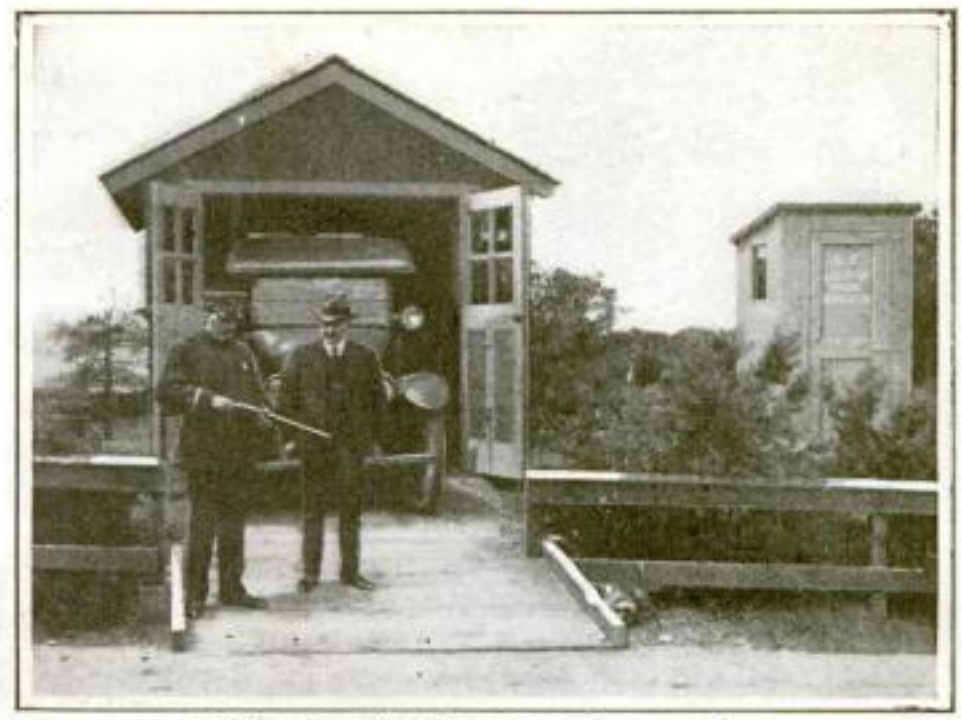
A RESIDENT of Brooklyn, Charles A. Marston, has patented a selective gear control with but one pedal for all speeds, including reverse and service brakes. It is designed to eliminate the objectional features existing at the present time in the Ford arrangement of three pedals close together.

With this device the operator needs to use only one foot to make all of the speed changes without removing his foot from the single pedal. It does away with the holding of the "low and high" pedal in neutral position with the left foot, when using the foot brake or reverse with the right foot.

The pedal, being free to slide sidewise, centers itself when released midway between its limits of lateral travel. If it is desired to start the car forward the operator would thrust the pedal to the left and press downward, at the same time releasing the hand brake. To go into high the pedal is let go which immediately centerizes itself so that when it is necessary to stop the pedal is merely pressed downward.



Gear shifting is all done with one foot on this Ford which has selective gears and a sliding pedal



California police look for stolen cars from this roadside station and thefts are reduced

To Catch Automobile Thieves

IN California, automobile thefts have become so common that special thief-catching stations like the one shown herewith are being erected on the outskirts of San Francisco.

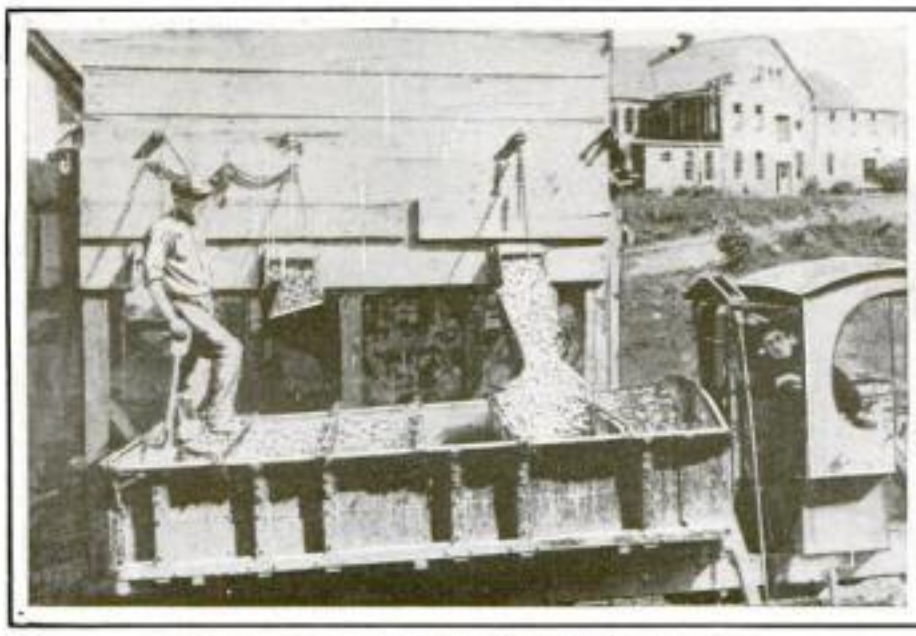
Each station will be connected with the headquarters police station by telephone and as soon as an automobile theft is reported, details of the car's make and style will be furnished to the men in charge. All cars of the same make as those reported stolen will be stopped and inspected, and the innocent motorist's good-nature may be sadly taxed.

Loads à la Carte from a Motor-Truck Body

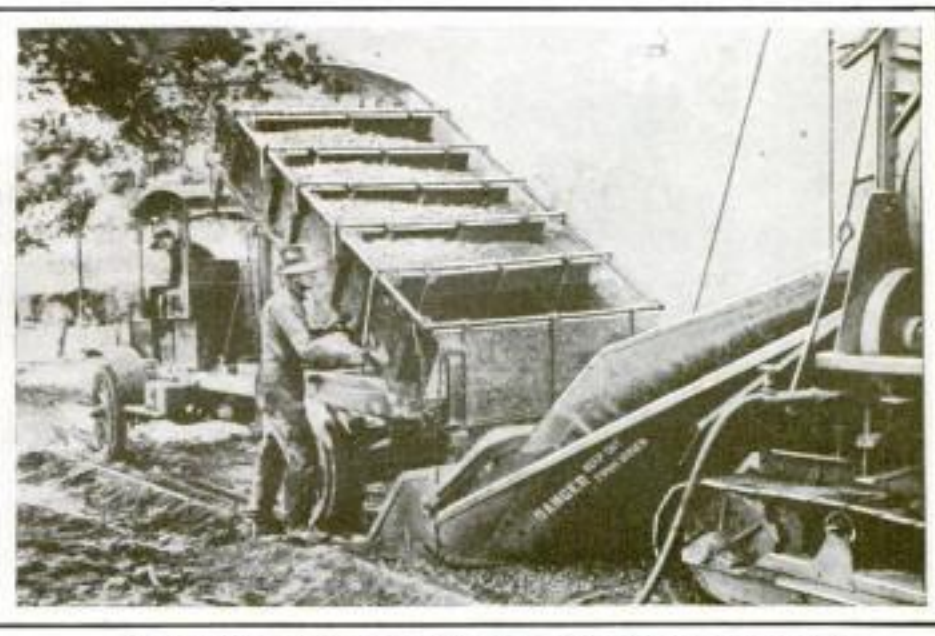
ONE of the greatest items of cost in laying concrete highways is the cost of the manaul labor in handling the sand and crushed stone from the points where they are dumped to the chute of the concrete mixer. Because these materials are usually dumped on the ground as near as possible to the mixer, wheelbarrows must be used to carry them to the mixer chute. The ratio of the mix is also done at the same time, a certain number of wheelbarrows of sand and stone being used to some set number of bags of cement. This process is wasteful in that more labor is required to clean up after the mixer has moved ahead in the progress of the work.

The above is the old method of doing the work. The newest way is to employ a special compartment motor-truck body which dumps its measured loads of mixed sand and stone directly into the mouth of the mixer chute and thereby does away with all handling and measuring and the labor of cleaning up. This new body forms the most interseting part of a special highway construction truck now offered by a New York truck manufacturer. When the truck is desired to carry machinery and the like, both sideboards and body tailgate, together with the compartment division boards, may be removed to provide a flat platform body.

There are five crosswise division boards hung from rods supported at the ends on the top of the body sides. Each board is held in position by three vertical plunger rods whose bottoms extend into holes in the floor of the



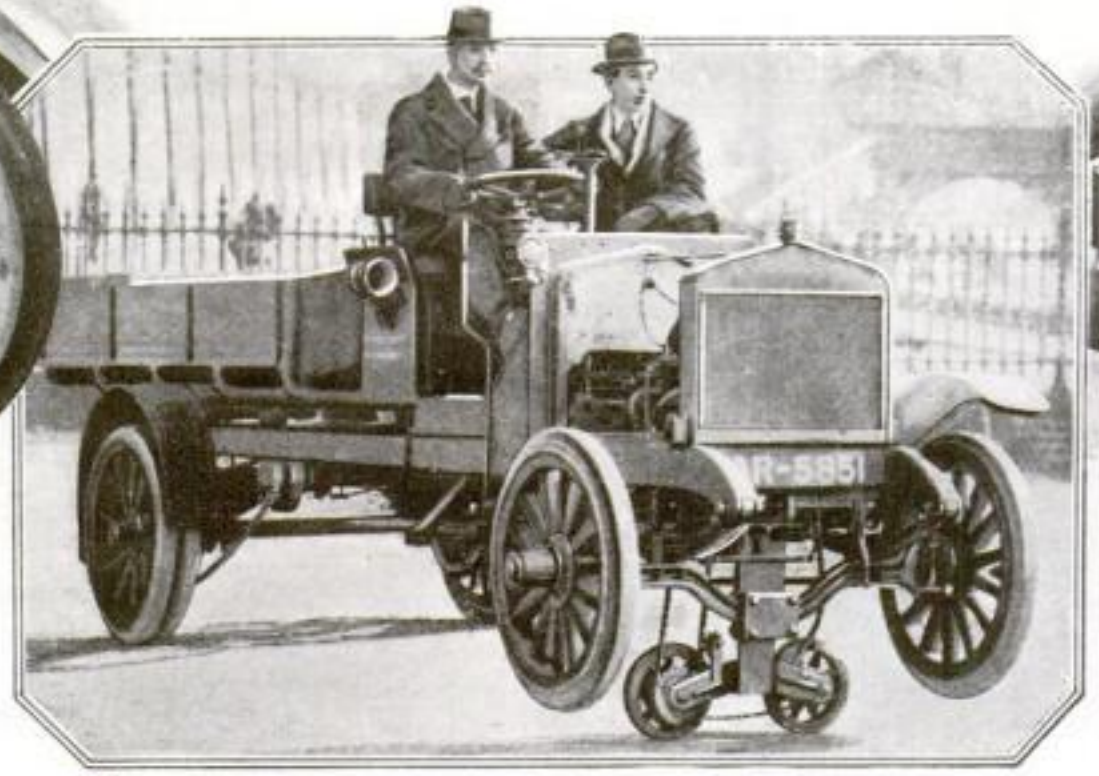
The truck runs under the dumping station and receives grade loads in a short time



A new way of dumping loads is to employ a special compartment truck body which measures its loads

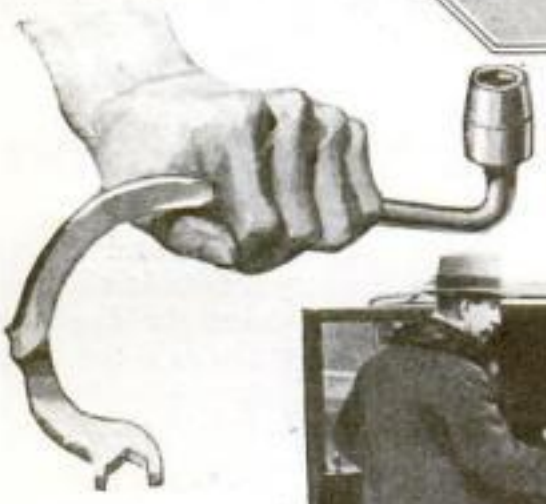
Why Don't You Buy Something

Here is the very latest in disk wheels for the automobile. These are made of thin aluminum or lygnite, the lightness of which is notable



Equipped with a newly invented turning gear, this truck is in use at a London railway station. The device, which is operated from the driving seat, enables the truck to be turned around in its own length

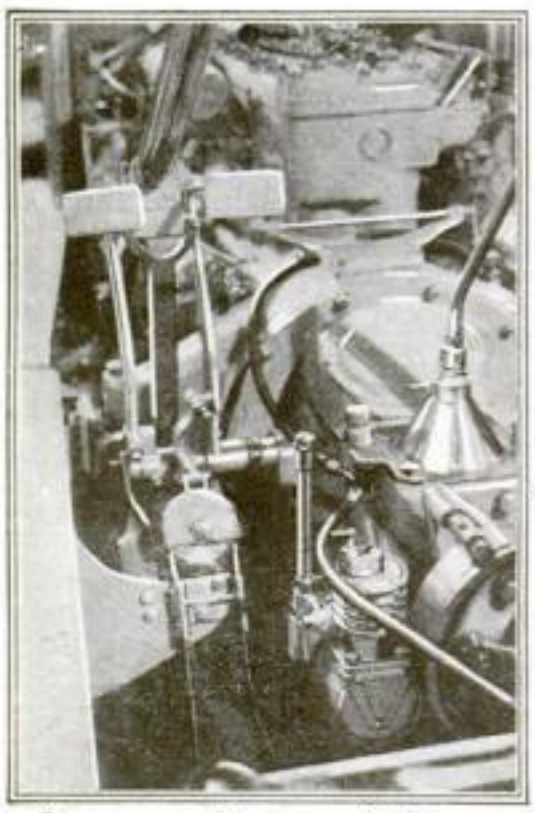
A new valve-lifter has no springs or catches to get out of order. It can be used to remove the valves of an automobile, truck, and of a tractor engine as well



The peculiar shape of this new wrench allows it to get behind the carburetor of a Ford car

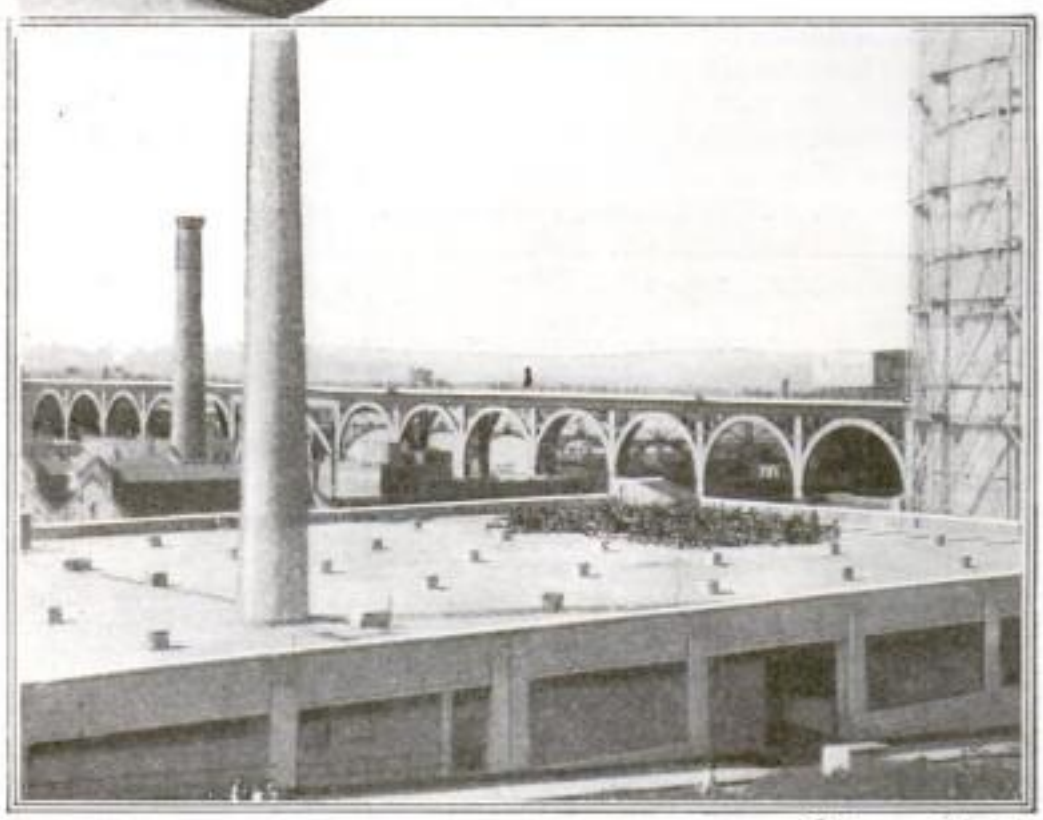
The three-wheeled taxi-cab has appeared in Berlin. The new vehicles help to improve the bad traffic conditions now existing in that city

The back interior of a sportster's front seat forms a table for writing in the car



One automobile manufacturer does away with human failings by providing an automatic brake-equalizer that puts pressure on both brakes equally

An inner tube is no better than its weakest part. A new tire valve will greatly assist in maintaining the amount of inflation that the proper length of tire life demands, and prolong its usefulness



© Keystone View Co.

With a view to future expansion, a bus company has constructed one of its garages on the plan of a sectional bookcase. The day more space is needed the additional story can be added to accommodate the increase in business

New for Your Automobile?

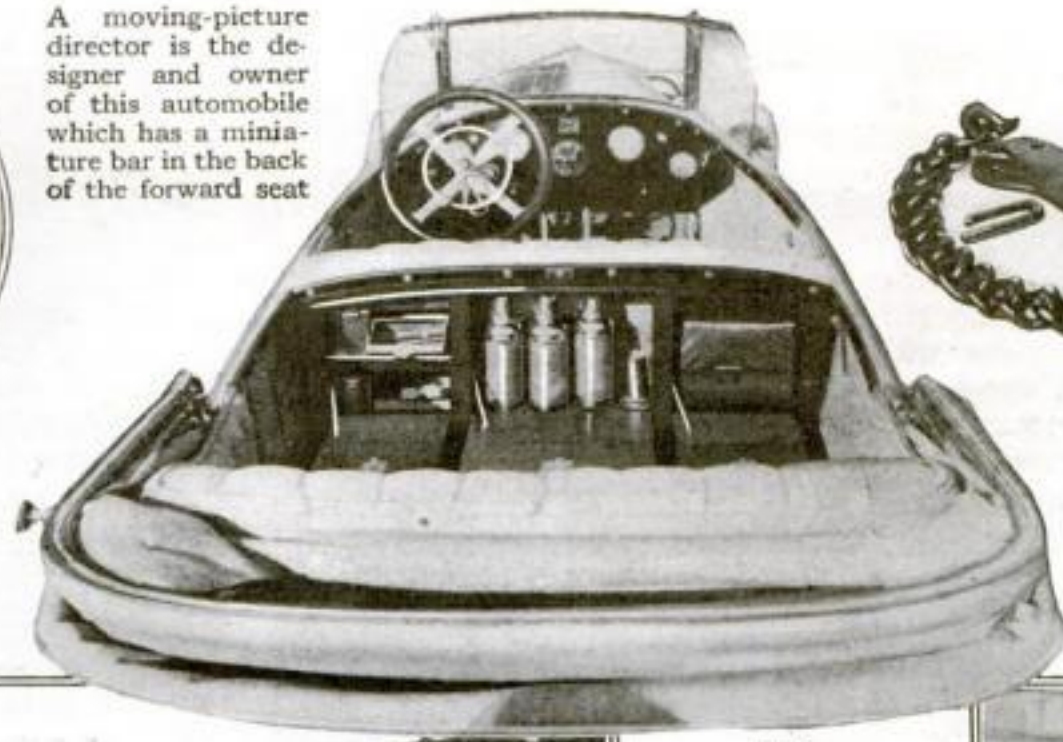
When a battery is opened by the old method, it is necessary **continually to reheat the putty knife. A new electric hot knife does away with this**

Here's how they do it at the automobile shows. The fire ordinance forbids gasoline. Tiny electric locomotives haul the small gasoline-driven cars up the incline into the hall

Built for automobiles and motor-trucks, this new tire combines pneumatic tires with an outer tire of solid rubber to give greater mileage and protection against punctures

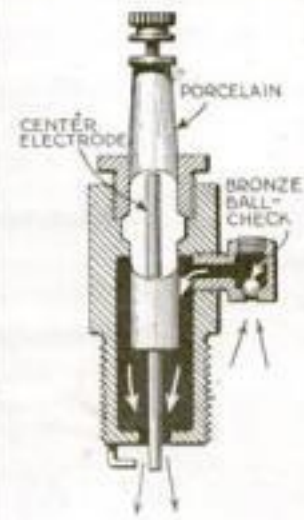
The dash instruments are all in one frame; ammeter, speedometer, clock, gasoline, and oil gages are centralized and glass-covered as in the picture

A moving-picture director is the designer and owner of this automobile which has a miniature bar in the back of the forward seat



Truck chains are difficult to attach and detach, and necessitate real labor. The one shown in the illustration is instantly attached and as readily removed and it will save time. It has only a few parts

Photographs of riders being thrown from horses are common, but here is one of an automobile in the act of overturning. It was taken on a French race-course at the instant a car tipped over



The self-ventilated spark-plug is provided with a ball-check valve through which air is drawn to keep the bottom of the center electrode free from any carbon or oil

Hiding the extra seats on a sportster is a new and attractive idea. They look like drawers

Keep an Automatic Fireman Under the Hood

AT last the idea of the fire prevention sprinkler system which has achieved such wide use in all forms of buildings, has been applied to the automobile and motor-truck by the development of a small sprinkler bottle which is placed under the engine hood and automatically empties its contents over the engine when the heat becomes sufficient to melt the fuse forming the cork of the bottle.

The successful application of this idea to the motor vehicle is really one of the greatest steps forward made in recent years, for this type of fire extinguisher has many advantages not enjoyed by any other type heretofore employed. In the first place, insurance statistics on automobile fires show that ninety-five per cent of all automobile fires originate under the engine hood. For this reason the sprinkler is placed on the front side of the dash under the hood where it is almost directly above the fire and can stop it before it really gets started. There is no running about, taking up seat cushions or rummaging in tool boxes to get the ordinary type of extinguisher while the fire is meanwhile gaining headway.

No chance of engine fire in an automobile having this extinguishing device

The sprinkler, which is made out of a green-tinted glass bottle, is filled with a special chemical compound and placed neck downward in a bracket attached to the dash. A fire is no sooner started than the fuse at the bottom of the bottle is melted and a fan-shaped torrent of chemical sprayed over the entire motor. An overheated engine cannot melt the fuse. Only an actual blaze will put the instrument into operation. It is the only combined automatic and hand-operated fire extinguisher on the market, for in case of fire in another part of the car, the bottle may readily be slipped from its bracket and employed by hand.

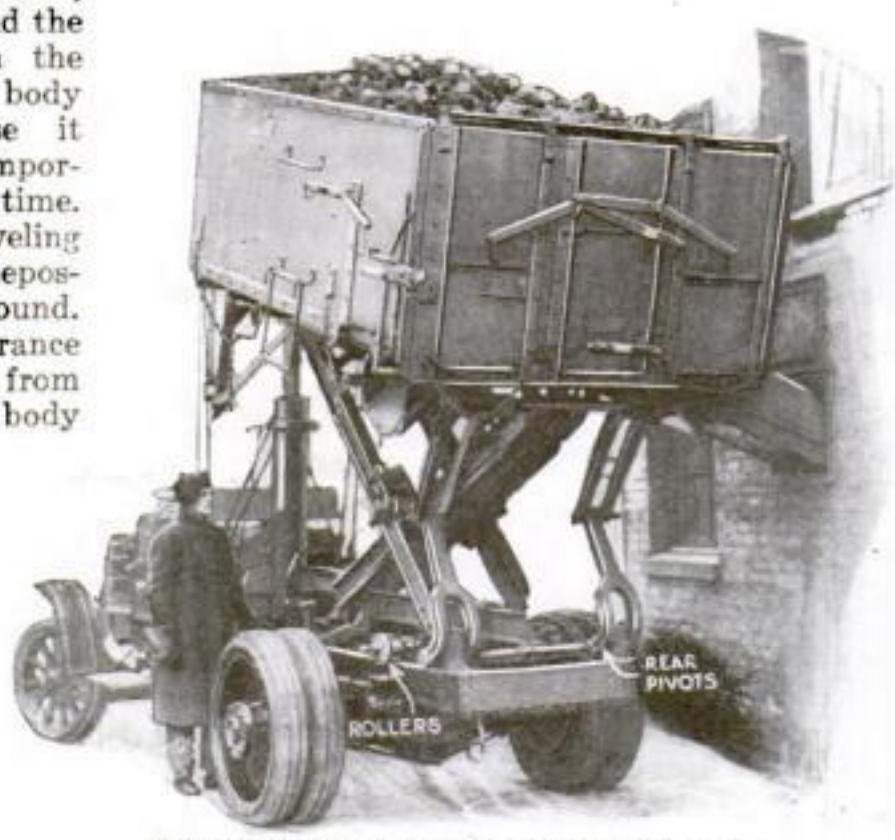
The fluid is chemically sealed by a special gum process at the fuse and will thus last indefinitely without chemical change or evaporation. The fluid will not freeze and is a non-conductor of electricity. It will not harm or burn operator or materials. When exposed to the air and heat, it effervesces, forming a blanket of heavier-than-air gas that smothers the flames.

This Self-Reliant Truck Is Its Own Body Booster

ONLY when a motor-truck is moving is it earning profits. No number of $5-a-day shovelers will keep a truck moving. Of the usual causes which prevent a motor-truck from being continually in motion from morning till night, that time taken for loading and unloading is perhaps the most important. Trucks must load and unload, for no sale is complete until the goods are delivered. Those truck owners who deliver sand, stone, earth, rock, coal and the like will be interested in the novel type of dump body shown herewith because it helps to reduce that important factor of unloading time. It also eliminates shoveling when the load has to be deposited other than on the ground.

While in general appearance the body is little different from the ordinary steel dump body such as those used by contractors, it has many unusual features. The most important of these is that it may be raised so that the rear end of the body is eight to eight and one half feet above the ground. This permits bulk material carried to be chuted directly from the rear end or side of the body into bins or hoppers without shoveling. Because of the steep angle of inclination of the body when in this position, from two to six tons of bulk material can be dumped by gravity in forty-five seconds.

The body is elevated by means of an unusually heavy hydraulic hoist placed on the chassis frame directly back of the driver's seat and operated by the engine. The rear end of the body may be pivoted to the chassis frame and made to dump just like an ordinary body when there is no necessity for dumping at a height above the ground. The extra high elevation is secured by mounting upon two pairs of folding cross stilts which open up as the body is raised by the hoist. When the body is lowered, these stilts fold underneath the body floor.



This truck either elevates its body load or permits bulk material to be chuted from it

The fact that the body functions like an ordinary end-dump type makes it suitable for transporting a great variety of miscellaneous materials. The high-lifting qualities may be used to advantage in connection with loading or unloading onto or from high platforms or unloading into hoppers or bins in construction work where wheelbarrows or chutes may be filled by gravity.

During elevation the body remains practically horizontal until the rear end has been raised to the desired height. Once this elevation is reached, the rear end remains stationary and the front end continues upward until it reaches its maximum elevation.

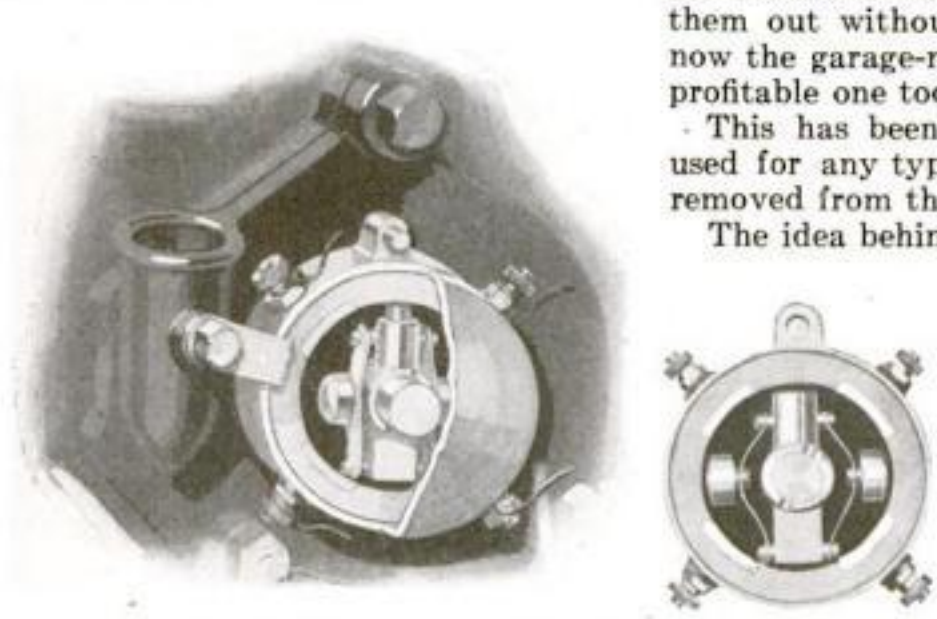
The operator can obtain any desired elevation of the tail-gate simply by adjusting a screw mechanism which regulates the distance the rear end has to travel upwards.

To Keep a Ford Engine from Racing

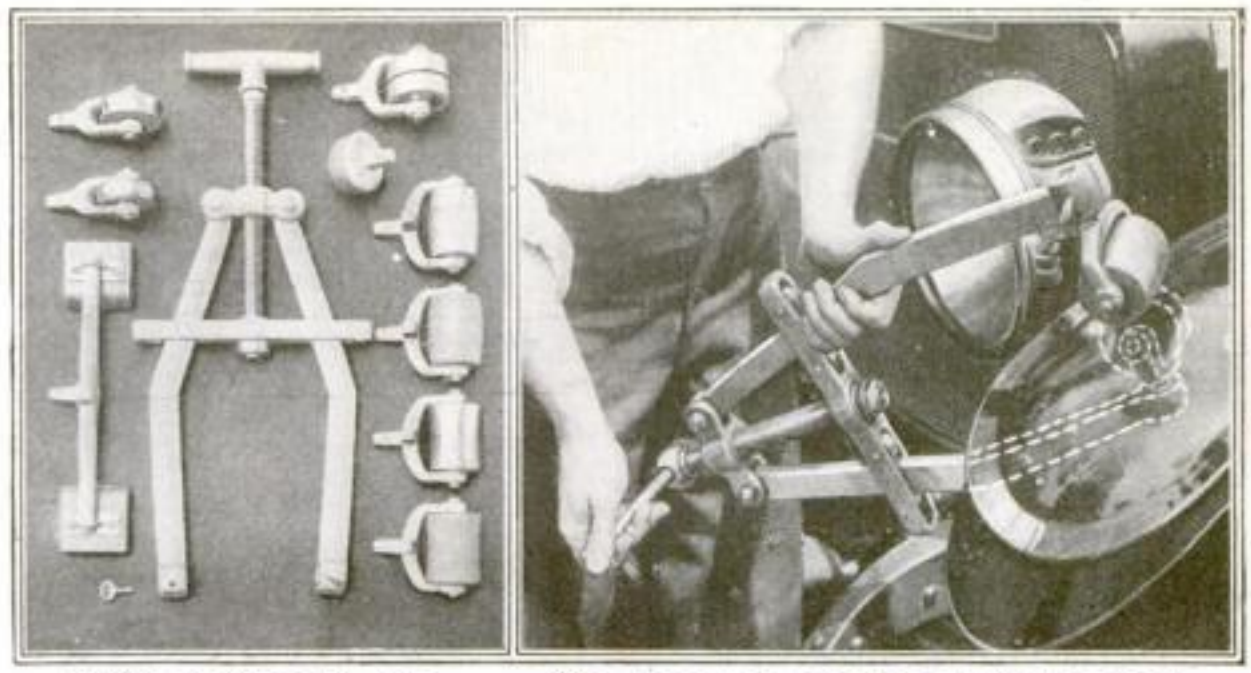
OF particular interest to those Ford-owners who operate converted passenger-car models or Ford one-ton trucks, the Ford governor shown in the accompanying views is not among those governors which do not govern. This one actually does govern the Ford engine speed because it automatically cuts out the ignition when the predetermined speed has been reached.

This does not mean that it governs the truck speed, for it is entirely possible to overspeed the truck when going down a hill, even with the clutch thrown out.

The governor is a simple affair, and is placed inside of the Ford timer where it takes the place of the regular Ford timer brush arm. It does not otherwise alter the principle of operation or the mechanism.



The Ford truck may over-speed and overheat its engine if it hasn't a governor to control revolutions



Dents are "ironed" out by pressure with this tool

The garage-man can now straighten motor-vehicle fenders easily without removing them

How to Straighten Bent Fenders

BENT and dented automobile fenders have always been an eyesore which motorists have allowed to remain because of the difficulty of straightening them out without taking them off and subsequently repainting them. But now the garage-man is able to make a business of straightening fenders, and a profitable one too.

This has been made possible by the development of a new tool that can be used for any type and size of front or rear fender which does not have to be removed from the car unless it is so badly smashed as to need renewal.

The idea behind the tool is pressure properly applied. This is done through the use of two wood blocks faced with soft pads and a series of different sized and shaped wood and metal rollers. The main part of the tool consists of a two-armed toggle framework, of which the ends of the arms are opened and closed by means of a threaded bolt inserted through a cross member between the arms, and turned by a handle at the other end.

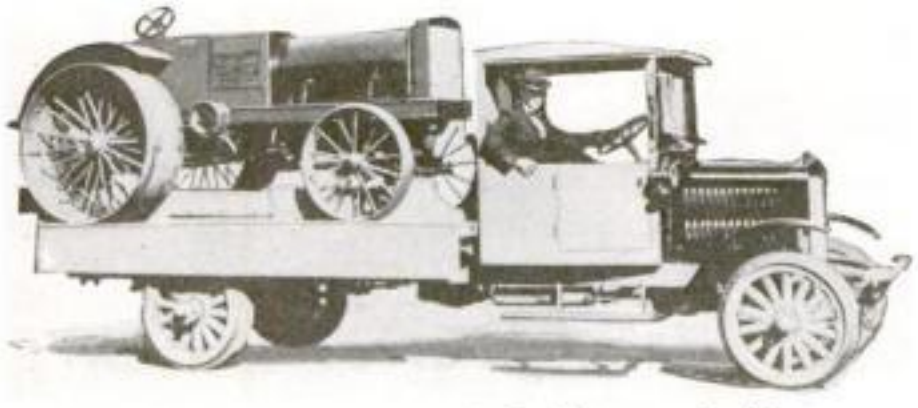
In operation, both the top and under sides of the fender should be cleaned of all dirt. Otherwise, the particles of dirt will be rolled into the enamel paint and mar the finish. The dirt may be removed most easily by simply rubbing off the surface with a clean, oiled cloth. The illustrations above show how a dent is removed.

Hauling the Tractor to the Farmer Saves Time

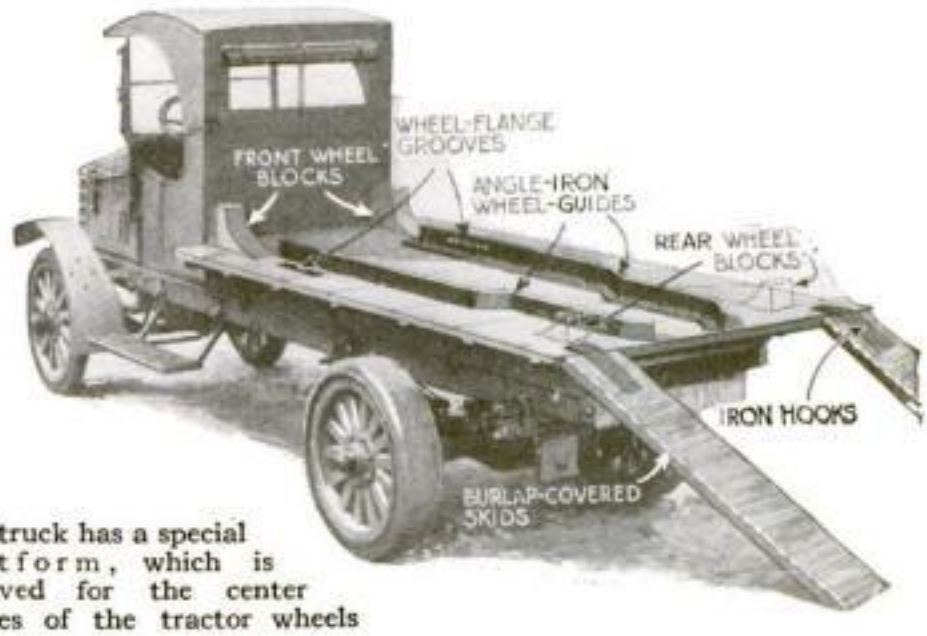
IN the great West and Northwest, where the largest number of the newer automobile-like farm tractors are in use, the problem of demonstrating them on the prospective purchasers' farms and later delivering them when sold has become very important.

One wide-awake tractor dealer has devised a special motor-truck for carrying the tractors home. Carrying small and medium types, it makes good time on the road.

The special platform body may be applied to any make of truck and the dimensions of the various parts changed to suit the particular type of tractor to be hauled. The farm tractor is driven up on the truck platform under its own power by means of skids covered with burlap to prevent slipping. When once on board, it is held in place while the truck is in transit as shown in the sketch.



After the tractor is run up the burlap-covered skids on to the truck platform, the skids are unhooked from the end of the truck body and placed between the tractor wheels for unloading the tractor again



The truck has a special platform, which is grooved for the center flanges of the tractor wheels

Reaching the Heights of Art in an Elevator

Without one few would visit the museum on the hill

By John L. Von Blon

WOULD you climb a small hill to see a wonderful painting? You may think that's a foolish question, but the sad fact has been proved that there are thousands of people in Los Angeles who never visited the Southwest Museum simply because it is perched on a hill.

The governors of the museum finally decided to install an elevator under the building, with a tunnel leading to it, thus enabling people to reach the heights of art without expending any extra energy on the way. Immediately the attendance increased from fifty or seventy-five visitors a day, to hundreds.

But the tunnel was crude and did not live up to the museum itself. So now the governors have decided to finish it off in the style of the ancient Maya architecture. The Maya developed a splendid civilization more than a thousand years ago in Central America and Mexico, and had a distinctive architecture. Their magnificent ruins still stand.

The late Dr. Hector Alliot, a distinguished scientist and for a long time director of the museum, had always wanted to preserve Maya art. The Maya portals of the subway will be a memorial to him.

The subway and shaft of reinforced concrete will cost at least $50,000. Nearly a year has already been devoted to the work. The tunnel is two hundred and eighty-one feet in length, and its mouth is just above the grade of the nearest street.

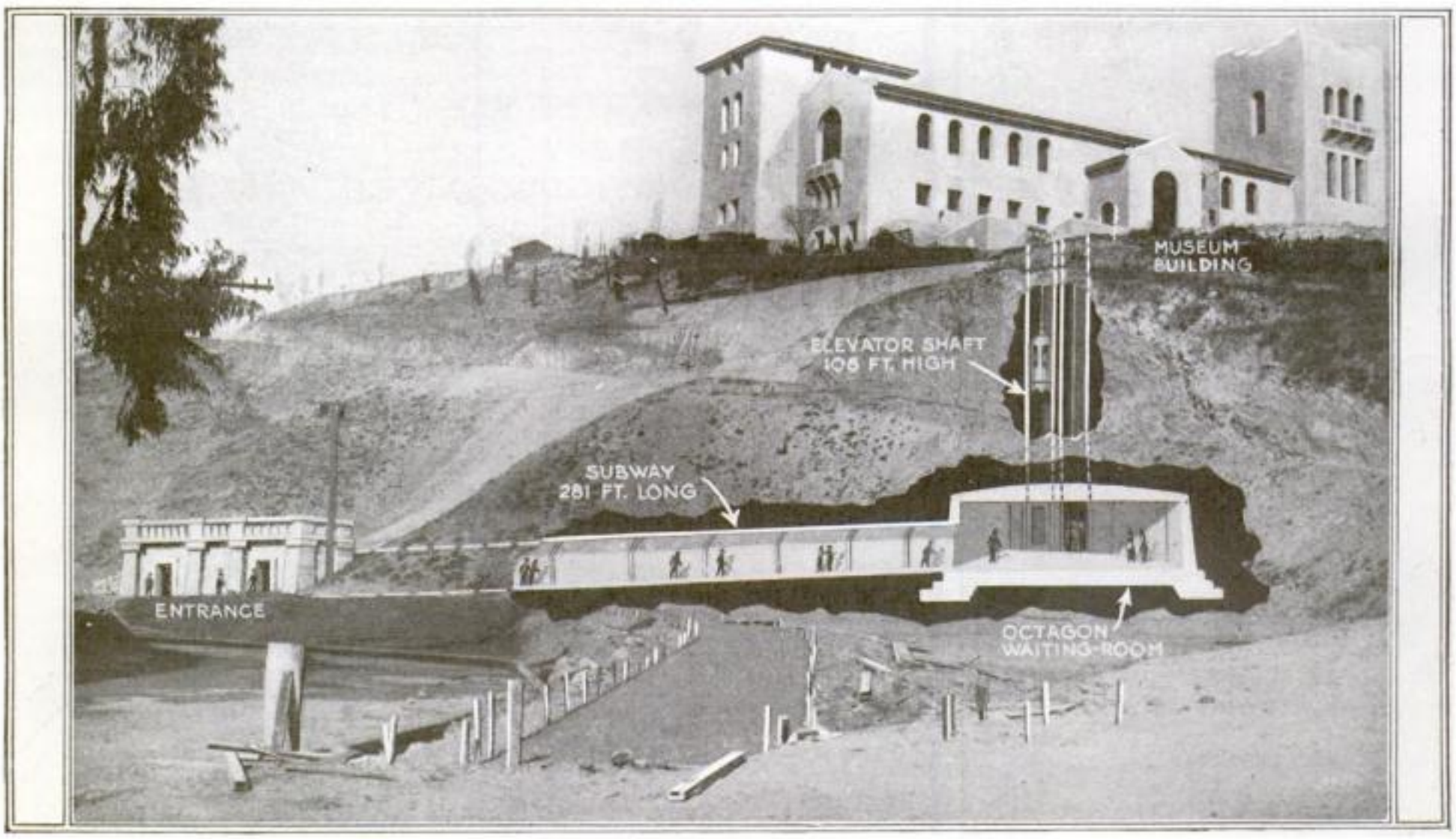
Miss Adelaide Chamberlin is superintending the job. The tunnel and elevator will be finished off in the style of the ancient Maya architecture, with which Miss Chamberlin, as an archaeologist, is well acquainted

The ornamentation of the waiting-room, subway and portal, is an immense task and will require years for its completion. Miss Adelaide Chamberlin, assistant curator in archaeology and ethnology of the museum, is directly in charge of this work. Miss Chamberlin, a frail girl of remarkable attainments in science and art, and a delver in archaeology since she was nine years of age, has superintended the entire subway enterprise and made all the designs. She has completed the one for the portal.

The bold use of serpent forms, characteristic of Mayan art, is strikingly exemplified in this magnificent piece. The modeling of this, together with all others in the scheme, is in the hands of Miss Marguerite R. Tew, a sculptress of talent.

As the Maya never built a true arch, but achieved only a peaked effect, that will be reproduced in the tunnel ceiling. Along the walls will be fifty sculptured pilasters and bas-reliefs alternating with deep niches containing habitat groups illustrative of the lives, homes and costumes of the aborigines of the southwest. The entire subway will be brightly lighted with an invisible indirect system.

The Southwest Museum is a public institution privately built and supported. It cost more than a quarter of a million dollars. The building itself is two hundred feet long. It has a tower one hundred and twenty-nine feet high or low, extending downward as far as upward because of the angle of the hill on which it is set.



The thirst for art was not great enough to induce people to visit the museum on top of the hill When a tunnel and elevator were built, the attendance increased tremendously

Cutting Down Operating Expenses

A little care and attention every so often will do wonders to your car

By Fred Gilman Jopp

This oil-can combines a measure, a strainer, and a funnel in the form of a flexible spout, which reaches otherwise inaccessible filling plugs and it prevents waste through spillage of the oil

ARE you one of those motorists who are afraid to take long trips for fear that something will happen to your car that you won't know how to repair? You needn't be for all we know about motor vehicles has been gained by observation.

Some fellows seem to be always having engine trouble, while others are constantly fooling with their tires. Another keeps his left foot constantly on the accelerator and the other on the brake, yet this chap rages like a dog with the hydrophobia when his car is towed back to the garage with a serious break-down.

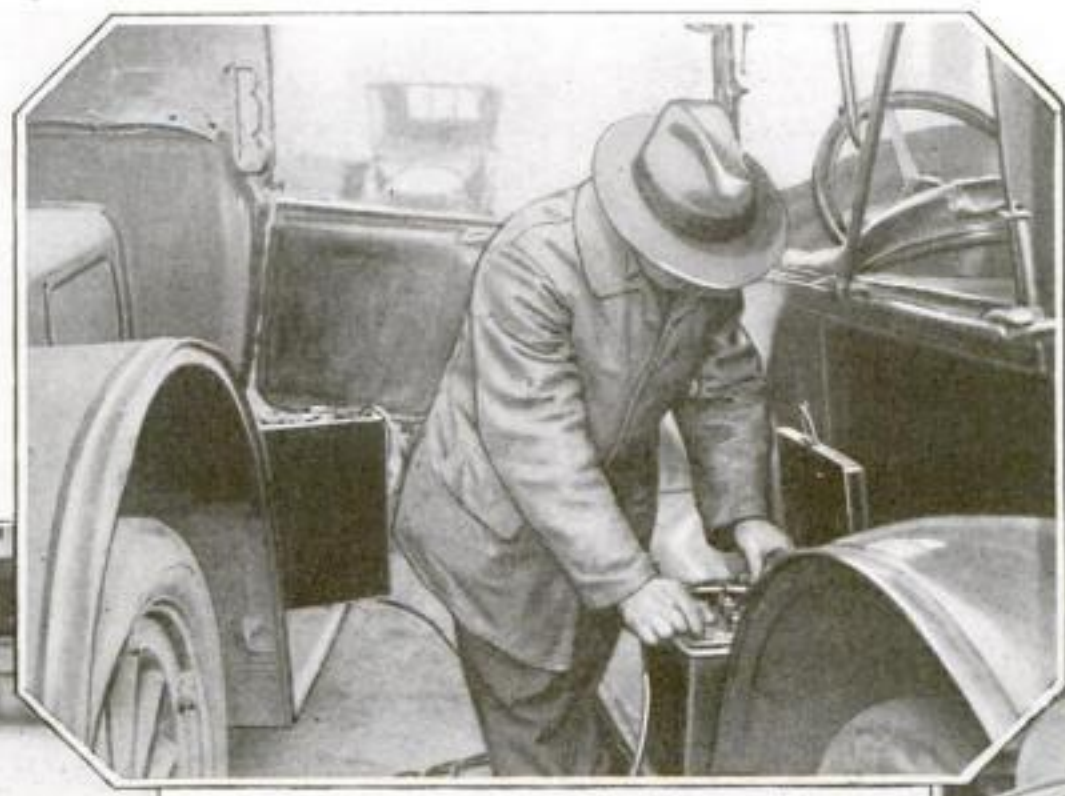
Nothing is more remarkable than the unparalleled advance of the automobile, especially in the last few years. Carburetion and ignition troubles have been overcome to such an extent that they no longer constitute a motor problem. Engine, axle and other troubles have been reduced until they are insignificant, so there is nothing left for the owner to do but thoroughly understand what is under the hood of his car, and give it the little attentions and cares that it should **and must have.**

The following gives some suggestions that will keep your engine and running gear fit. If you take pride in a quiet running engine you will appreciate the advice which will help you keep away from the repairman.

The number of miles obtained from a gallon of gasoline depends not only upon the grade of fuel bought but upon the condition of the engine in which it is burned. It would be a good thing generally if owners who are complaining about low gasoline mileage and blaming it on the quality of the fuel, would also examine carefully the condition of their engines. The condition of the cylinders, the tightness of the piston rings and the condition of the valves, all have their influence on gasoline mileage. If the cylinders are slightly scored, the piston rings loose and the valves seating improperly, it is no wonder that gasoline mileage is low, even granting that the present day fuel is inferior in quality to that which could be purchased two or three years ago.

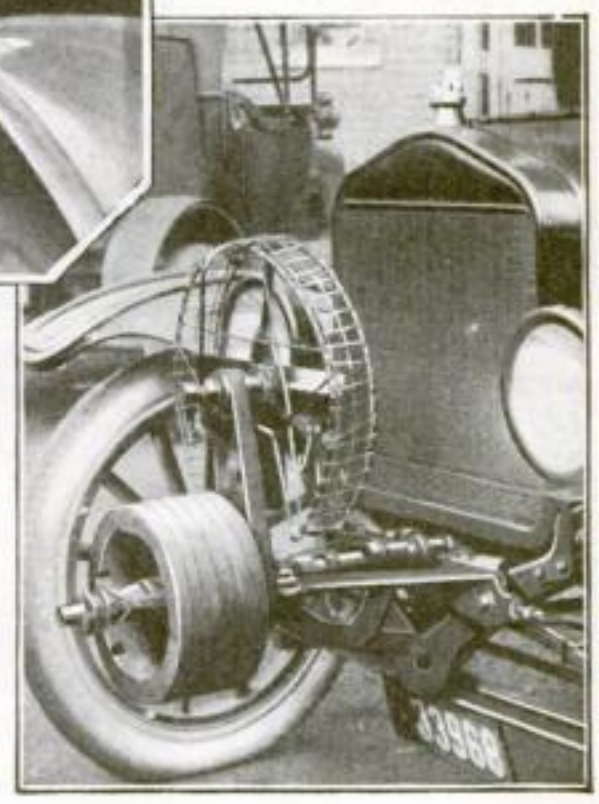
If loss of power is due to a faulty carburetor adjustment the trouble is more likely to be on the side of an adjustment which is too rich. The exhaust smoke is usually black or will have the odor of raw gasoline. A simple test is to shut off the flow of gasoline to the carburetor and allow the engine to run without touching the throttle. If the engine speeds up as the level of the gasoline drops in the float chamber it is an indication that too much gasoline is being supplied under normal conditions when the chamber is full. Such a mixture causes not only loss of power, but also overheating, carbon deposit, and possibly pre-ignition.

It is not sufficient to know that the generator with which an up-to-date car is equipped is charging when the engine is running. It must be definitely known that the current generated is neither more nor less than is required to keep the battery properly charged. The amount of electrical current developed by a properly **functioning generator** is practically constant, while the amount consumed by the use of the various instruments which are supplied by the battery is never constant. It is evident, then, that a battery may be either overcharged or undercharged by a perfectly normal generator.



Stranded on a country road with a weak battery. Connect a wire to the positive terminal of the passing car's battery and the positive terminal of the stranded one, also a wire to the negative poles. This will start the stranded car and give its battery a chance to recharge

This motorist reasons, and correctly, that if carbon can be burned from the cylinders, it can be burned off the plugs. The plugs are put around the gas flame about an inch away, and left until the points are red-hot



This attachable device turns your Ford into a power plant for driving all kinds of machinery. The fan is guaranteed to keep the engine cool and the water below the boiling-point at 1,100 revolutions a minute

The general belief that the electrical system is equipped with a cutout to prevent overcharging is erroneous—it has no such duty. Its duties are, however, first, to close the circuit when the generator is not operating, so that the current in the battery does not run back or discharge through the generator; second, to conceal the rate of current passed to the battery when charging, but not to control the amount of current.

The battery should be tested weekly to ascertain that it is being properly charged. It must be supplied with water regularly in order that the electrolyte may be sufficient in quantity to keep the battery properly filled. A battery deteriorates almost as rapidly when idle as it does in use, for the active ingredients of which a charged battery is composed are constantly in operation whether the battery is in use or left standing. It is therefore evident that a battery cannot be left idle in its normal condition and retain its usefulness.

Next to the tires on a car its brakes are subjected to the greatest wear and tear. It is well to remember this and to watch them carefully.

Brakes require readjustment from time to time. Both the service brake bands and the emergency brake shoes, in operating against the brake drums, must form true circles or they will not take hold evenly all the way around and, of course, will drag when released.

The one fault reduces the effectiveness of the brake, the other the speed and economy of the car's performance.

In many States it is a penal offense to drive a car with worn brake linings. They endanger not only the driver, the passengers and the car, but the public as well.

Their replacement is an immediate duty. It is a simple operation, performed quickly, at slight expense by a reliable service station.

If the rear axle makes a "howling" noise when the car is under way it is a sure sign that the bevel gears are not adjusted properly, allowing too little or too much backlash. Bevel gears in use to-day have a method of adjusting the depth of the mesh obtained either by moving the whole differential unit sideways or by movement of the driving pinion. Either fix it yourself immediately or take it to your service station. Once the gears wear into their wrong adjustment the only remedy is to have an entire new set installed.

Wheels out of true will grind the rubber off your tires. When your wheels are not in proper alinement they run at a slight angle to the direction your car is traveling, which of course produces a severe grinding between the tread and the road and wears down the casing at the point of contact in a surprisingly short time.

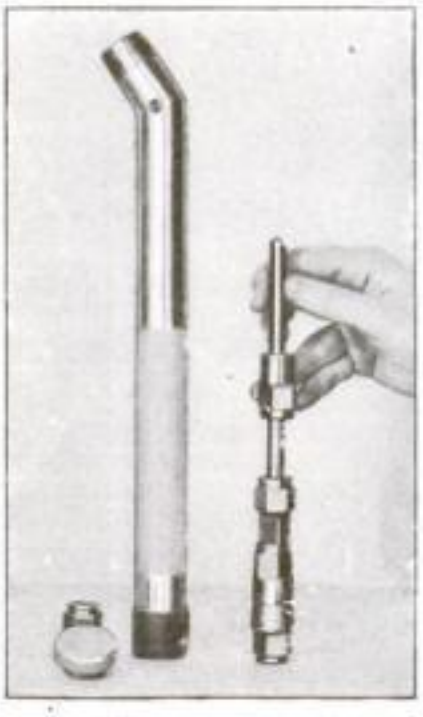
A fairly exact way of determining whether or not your wheels are out of line is to use a straight edge and measure between the felloes of the wheel or the edges of the rims on the wheels at the point directly in front of the front axle. Mark this distance carefully and measure in the same way across the wheels directly back of the front axle or opposite from where the first measurements were taken. The difference between these two measurements will be the amount the wheels are out of true. If any is found it should be corrected immediately.

Save those old oil stove wicks that your wife usually throws away. If slit in half and laid flat they will form an excellent remover of grease and grit from your hands and save wearing out the costly towels. The wicks should be kept in a tin can and moistened frequently with kerosene.

A very good way to prevent oil leaking out of the crankcase through the bolt holes, is to back off the studs ¼ in. or so and then wind several turns of cotton twine around the loosened bolts. When the studs are tight again the leakage will have disappeared completely.

An expert gives the solution of repairing curtain lights. When removing the old celluloid, rip only the inner seam. Place the new sheeting in the groove and then sew on a machine. Saved, three dollars and seventy-five cents by this simple method

One advantage of a removable driver's seat is that you may put whatever chair is desired in its place. Here is a wicker one



In the steel casing are held six different sizes of socket wrenches. The rod on which the wrenches are held is slipped through the holder at the top of the steel casing, and used as a handle for removing them

A folding writing-desk was put in this town car. Does this suggest a way for you to combine work with pleasure?

THE HONOR OF THE ACCO FAMILY

Weed Chains for Motor Cars!
Anchor Chains for Ships!
Chains for Railroads!

Devices that make travel safe on land and sea, that can be absolutely depended upon to protect human life, are typical of the nature and quality of Acco products.

The workers who make up the Acco family know they are doing more than making commodities merely to be sold.

They know that it is their work that holds millions of motor cars and trucks to slippery roads.

It is their work which enables mighty ships to ride safely at anchor, whether in harbor or helpless on a lee shore.

It is their work which makes possible the safe operation of thousands of railroad trains.

This gives the work of the Acco family honorable and distinctive responsibility which is reflected in every link of every Acco product—"From Plumbers' Safety Chain to Ships' Anchor Chain."

In the Acco family, loyalty to the work itself is rated above everything.

This is true of every worker whether the job is directing all of the numerous plants, or operating a 2,000,000 pound tester, or a typewriter.

The honor of the Acco family is in the hands of each member of it, even to the youngest worker.

These are the reasons why it is possible to say not only that "Every Weed is Guaranteed" but that every link in every chain made by the American Chain Company will hold for the purpose intended.

The big ACCO Line includes chains for every purpose—from Plumbers' Safety Chain to Ships' Anchor Chain—all Styles, Sizes and Finishes

AMERICAN CHAIN COMPANY

INCORPORATED

BRIDGEPORT, CONN., U.S.A.

In Canada- Dominion Chain Co., Ltd., Niagara Falls, Ontario

GENERAL SALES OFFICE: GRAND CENTRAL TERMINAL, NEW YORK CITY

DISTRICT SALES OFFICES: BOSTON, CHICAGO, PHILADELPHIA, PITTSBURGH, PORTLAND, ORE., SAN FRANCISCO

Largest Manufacturers of Chains in the World

All Styles, Sizes and Finishes

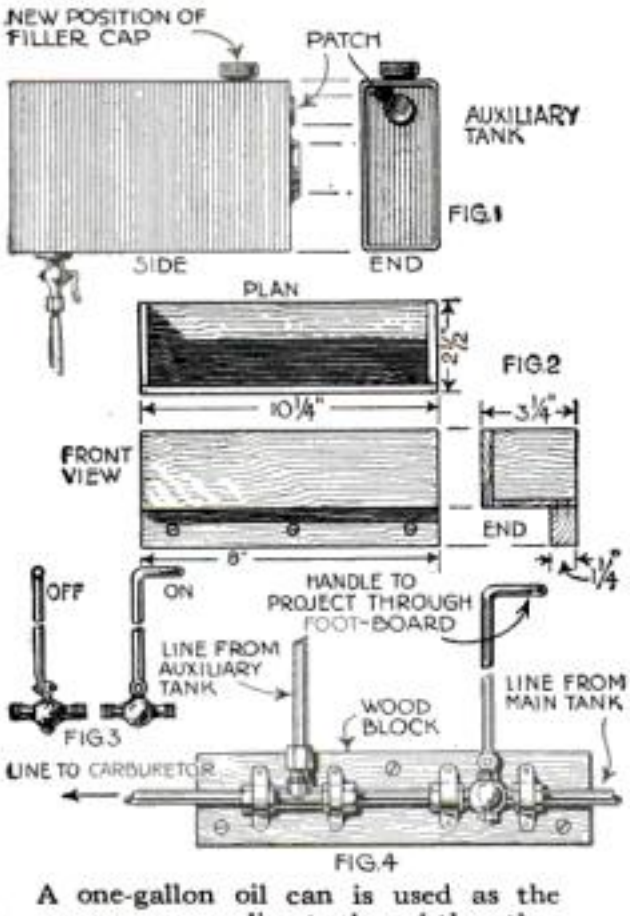
Extra Gasoline for Hill Climbing

How the little Ford can be made to ascend a hill however steep

By J. S. Chapman

FORD owners who travel in mountainous districts will call to mind many hills that can be climbed only when the gas tank is full. Occasionally one meets a grade that must be climbed wrong end first, in order to keep the gas in the carburetor. As these hills occur most frequently on unmade roads, this method of going up in reverse is not only difficult but dangerous. Having been stalled several times in this manner, I have solved the difficulty by fitting up an auxiliary tank which can be turned on or off as required.

A one-gallon oil can was converted into a tank. It is flat, and fits on a wooden bracket attached to the extreme right of the instrument board. This is the cheapest and simplest way of fitting a tank, though a more finished job could be effected by having



A one-gallon oil can is used as the emergency gasoline tank and the other parts are picked up at a very slight cost, or found about the home garage

a tank especially made to fit under the cowl of the dash out of sight. However, the oil can on its bracket when painted black, is not unsightly and does not interfere with the passengers' outlook.

The fittings necessary are: two ¼ in. brass gas cocks, one T-piece, about 4 ft. of brass or copper tube, and a short length of ¼ in. iron rod. If solderless pipe fittings are obtained much time will be saved in making the joints.

The oil can should be washed out with kerosene, a hole punched in the bottom and one of the cocks soldered in. Next, while your soldering iron is hot, run it round where the screw stopper joins the can and melt the stopper off. This must be re-soldered to the can on the side opposite the tap, as this side now becomes the top (Fig. 1). A patch cut from any scrap of tin is soldered over the hole left by the stopper. The stopper should not be cut out with snips, as this method leaves a ragged edge. By heating it off, a clean edge is left ready for putting on the other patch. The bracket can next be made of a few bits of wood cut approximately to sizes shown in Fig. 2. The bracket is attached with three wood-screws, and the tank strapped into position. One end of the copper tube can now be attached to the tank and bent forward and downward to lie along the dash. Remove the foot-board and lead the pipe down to the pipe-line to the carburetor. It is now necessary to prepare the other cock by fitting it with a handle to project up through the foot-board. One end of the iron rod is flattened out, then a flat is filed on one side of the handle of the cock, and an ⅛ in. hole drilled through both, where a small bolt or rivet will hold the rod firmly in position (Fig.3). The rod is held in a vise and bent at right angles so that it will be parallel to the pipe line when the cock is open (Fig. 3). The T-piece may now be attached to the cock by a short length of pipe and the two fittings cleated to a wooden block (Fig. 4). The block is not essential, but it is much easier to attach the unit than to cleat on the cock and T-piece separately. This block with fittings attached can now be screwed or nailed onto the wood of the body just behind the dash, and the pipe from the tank connected to the T-piece. All that remains now to be done is to turn off the cock under the main gas tank, then cut and fit the pipe line to the cock and the T. Before connecting pipe line to carburetor, a little gasoline should be run through from the auxiliary tank to make sure that the pipe is clean and free from stoppages. When replacing the foot-boards a small notch should be cut in one of them for the handle from the cock to come through. For normal running the tank is kept full and the cock beneath it shut off. The iron rod handle runs fore and aft of the car when the engine is feeding from the main tank. On approaching a bad hill it is only necessary to open the cock under the auxiliary tank, and cut off the supply from the main tank by turning the iron rod at right angles to the pipe line, *thus preventing the small tank emptying itself into the big one.*

The height of the small tank insures sufficient pressure to keep gas in the carburetor whatever the angle of the hill. Also a gallon of gas in a 'gravity tank' *weighs* less than ten gallons in the main tank!

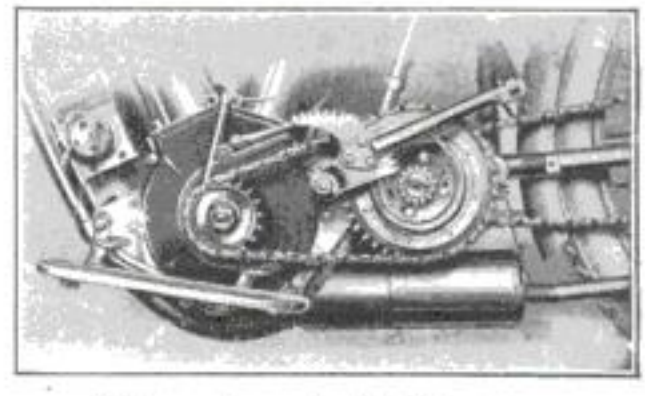
How the gravity gasoline tank will appear when attached to the dashboard of the car. Notice that it will not obstruct the view of the passenger

Incidentally this tank forms a very convenient means of carrying a spare gallon of fuel, as it can be emptied into the main tank when required, by simply turning on the cock.

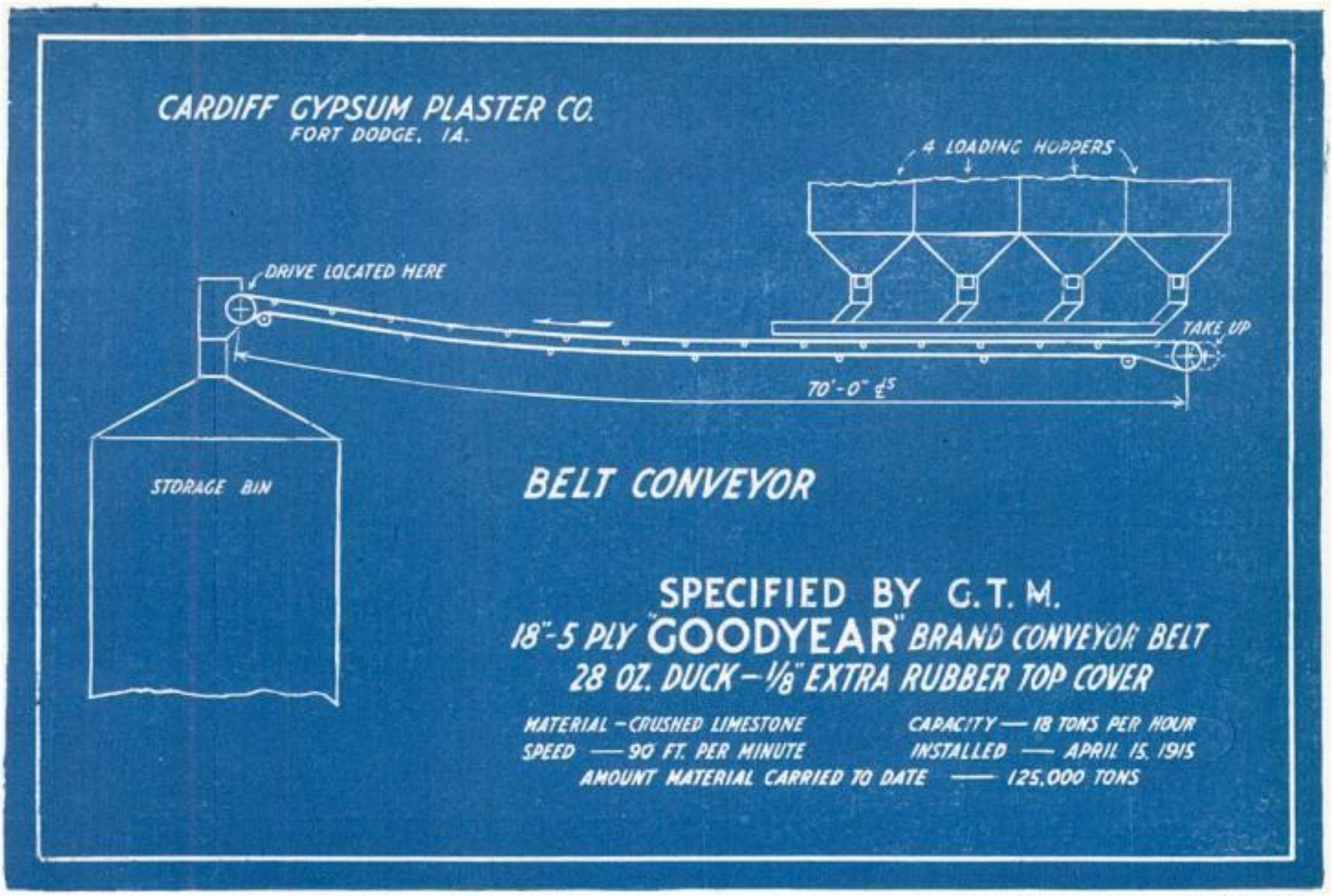
How a Motorcycle Motor is Started

THE initial impulse necessary to start a motorcycle motor is given by means of a "kick starter" acting through the clutch and front drive chain. The clutch carries a rachet pinion, meshing with a toothed sector, pivoted on the motorcycle frame. To this the starting lever and pedal are fitted.

With the clutch engaged and transmission gears in neutral, a short thrust downward on the pedal engages the teeth on the sector with those on the ratchet pinion and the motor is "spun" through the drive chain leading from the clutch to the motor sprocket. One "kick" on the starter results in two compressions in the motor. On being released the arm is forced back to its up position by a spring, and is held stationary by a stop. It is then ready for use when the motor is again to be started, without further attention on the part of the rider.



The motorcycle "kick" starter showing the working parts with the chain cover guards removed



125,000 Tons of Stone—and the G. T. M.

The requirements called for a belt with character. The G. T. M.—Goodyear Technical Man—could see that, from the very beginning of his study of the original conveyor installation for the Cardiff Gypsum Plaster Company, at Fort Dodge, Ia.

The conditions of service would be unusually severe—handling gritty, abrasive limestone, fed to the conveyor in sharp lumps averaging two inches in size. No previous experience in this mill furnished a working basis for suggestions. This was as much a test of the Goodyear Plant Analysis Plan as it would be of the belt.

You may be sure that every item affecting the efficient operation of that conveyor went into the G. T. M.'s calculations. The officials gave him full access to plant records. He figured the belt speed per minute—90; the diameter of head and tail pulleys—20 inches; their nature—bare; atmospheric conditions—damp; method of loading—from four automatic chutes; condition of bed—level; all equipment in first-class shape and well attended; weight of load—110 lbs. to the cubic foot; tonnage to be carried—18 tons per hour—day in, day out—10 months a year.

The belt he recommended is the 145-foot Goodyear Conveyor that is in operation today with five years of trouble-free service to its credit, and a record of more than 125,000 tons conveyed. It has gone on working amid the prevailing damp with all the unconcern of its moisture-proof construction. Judging by its condition today, Supt. C. C. Collins estimates that this 18-inch, 5-ply, 1/8-inch cover Goodyear Conveyor will stand up just as consistently to six years more of service.

Goodyear Belt performance like this is not measurable in first cost. The Cardiff Company's officials noticed when the G. T. M. figured on their problem that the belt he prescribed cost a little more than other conveyors. But their investment of that little additional secured them a balanced belt, specified exactly to their conveying—an earner and a saver every hour of its life.

The G. T. M. and Goodyear Belts, the idea that squares with your needs and the belt that we build to protect our good name, are available for your conveying and transmission. For further information about the G.T.M.'s services, write to The Goodyear Tire & Rubber Company, Akron, Ohio.

BELTING • PACKING • HOSE • VALVES

GOODYEAR

Things to Know About Lathe Tools

By Ronald L. Prindle

IN the making of high-speed steel tools for use in a lathe, the tools are heated to a point where their tips begin to melt. When a tool is so heated, it is immediately plunged into oil, or else buried in common salt until thoroughly cool. It is not generally known that carbon steel gives the best results when heated to a dull red and plunged into oil.

Only the tool point proper should be heated to the plunging temperature, the heat being slowly applied at first and then the blast turned on gradually. The tool should be plunged into the oil when the heat is increasing, and at the instant it reaches the plunging temperature, which in the case of carbon steel is when it is dull red. This is very important in the treating of high carbon steel, as heating the steel to white hot, then allowing it to cool to a dull red, makes a very poor tool.

Carbon steel tools must always be tempered. There are two ways in which this must be done, the best being to plunge only the point of the tool in oil after heating it to a dull red, thus leaving some heat in the heel of the tool.

When the point becomes black, remove the tool and rub the cutting edge with emery paper mounted on a stick. Care must be taken to watch the point closely and, as the heat is driven from the heel to the point, the color of the surface being polished will turn light straw color, dark straw and blue. As soon as the point of the tool turns straw color plunge the entire tool in oil and cool it completely. The other way of tempering is to cool the tool immediately after the first heating, polish the point, slowly heating it again to straw color and then plunge it.

A. Bull Nose. *B.* Left Hand Diamond Point. *C.* Cutting Out Tool. *D.* Inside Tool. *E.* Inside Threading Tool. *F.* Round Nose. *G.* Straight Threading Tool. *H.* Inside Boring Tool

Almost any kind of a grinding wheel can be employed in tool grinding, but one should remember not to draw the temper out in any way, and not to burn the tool. The tool is held lightly against the wheel and occasionally cooled in water. In this way tools are ground to the shapes shown in the illustration, the shape, of course, depending upon the work to be done at the time. Finally, finish the cutting edges neatly with an oil stone.

An Experiment in Perpetual Motion

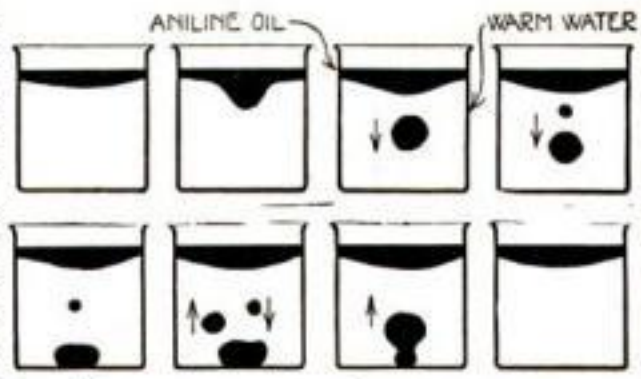
By A. Swenson

THIS is an interesting example of the transformation of infinitesimal amounts of heat into motion. When first viewed it seems to be the long-sought-for perpetual motion. The experiment can be performed without any special apparatus and requires only a small amount of aniline, which is inexpensive and easily obtainable.

Heat some water to nearly the boiling-point and put it into a glass vessel so that the action can easily be seen. A chemical beaker is fine for the purpose.

Into the hot water pour a quantity of aniline which will lie quietly for a while on the surface of the liquid. Soon however the center of the aniline will assume a rounded form and then a large drop will gradually detach itself from the main body of the aniline, the skin of the upper layer quivering in a peculiar fashion after the separation. The long neck remaining on the upper surface then detaches itself and forms two or more spheres, usually one large and one small.

While this has taken place the large drop which was in a more or less flattened form on the bottom of the beaker becomes more and more round and finally becomes spherical and after a brief interval of hesitation rises to the top and mingles with the original liquid. In a moment another drop is released and after an interval goes upward also. The action is automatic and continuous, and owing to the large size of the drops the entire action can be studied with ease.



If you want to invent a perpetual motion machine — here is an experiment to start with

L O N G W E A R

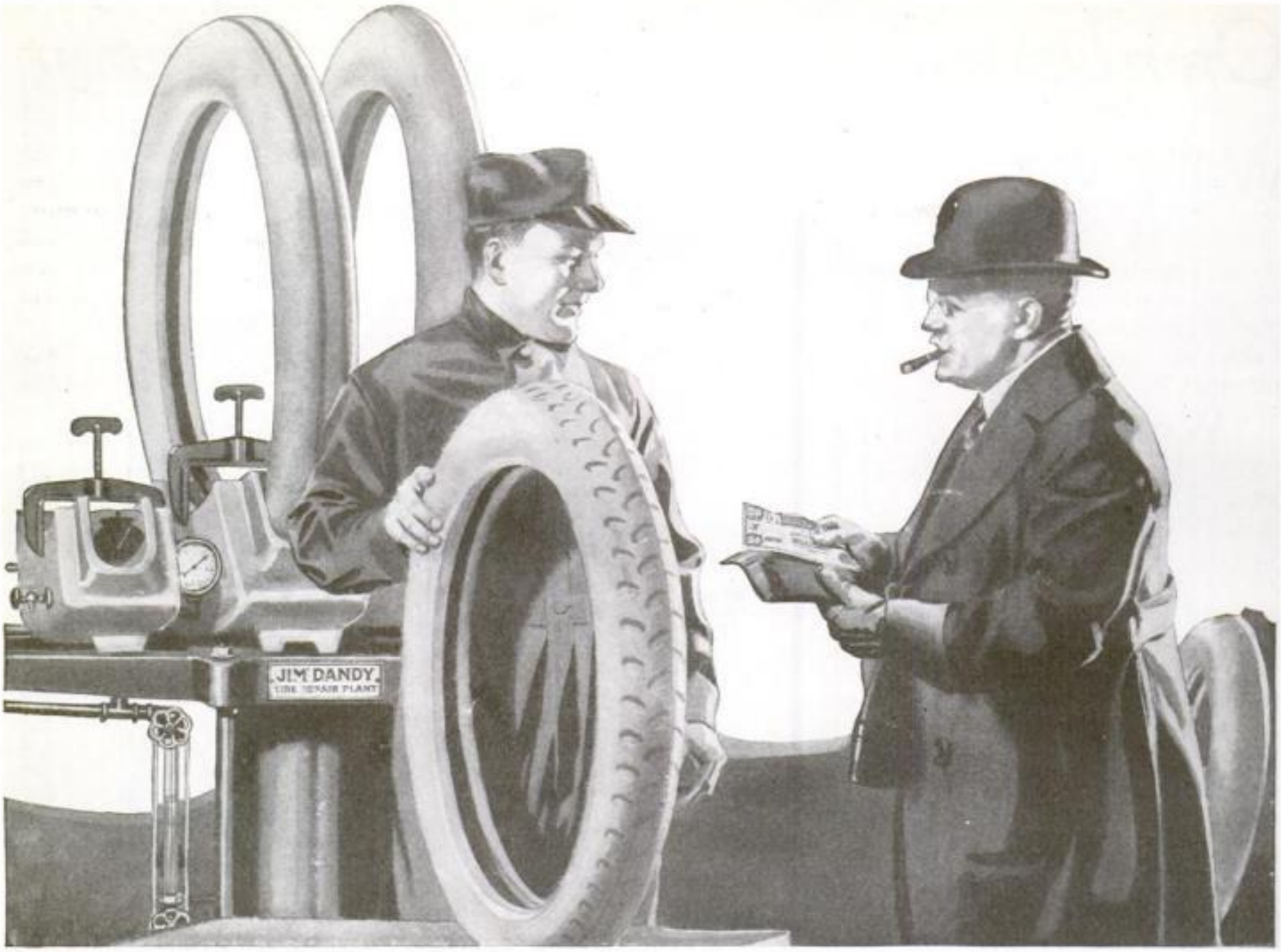
MATERIALS OF ENDURING STRENGTH AND WORKMANSHIP OF SCRUPULOUS CARE MAKE B·V·D· WEAR FAR BEYOND WHAT IT IS FAIR TO EXPECT

NO UNDERWEAR IS B·V·D· WITHOUT THIS RED WOVEN LABEL.

MADE FOR THE B.V.D. BEST RETAIL TRADE

Trade Mark Reg. U.S. Pat. Off. and Foreign Countries

THE B·V·D· COMPANY.
NEW YORK



Make Big Profits Repairing Tires

DO you want more money? Do you want to get into a fast-growing, uncrowded business where you can make from $250 to $500 a month the first year? Do you want to be independent? Do you want to share the profits in the richest industry in all America?

Of course, you do. Then investigate the tire repair business—and do it now. The Jim Dandy Tire Repair Plant is making money for many men. It can do it for you.

Fortunes have been made in all lines connected with the automobile industry—but none has ever offered greater opportunity than tire repairing with a Jim Dandy Plant offers you today. The tire repair men of America have a $200,000,000 business ahead of them this year. Think of it!

By January 1st, 1921, there will be 40,921,076 tires in use in this country. Every one of these tires must be repaired some time. More tire repair shops are needed. Big, profitable business is waiting for them. Do you want it?

Business Is Going Begging

This is your opportunity. The tire repair industry needs business men of ambition and ability. The field is uncrowded—the number of tires to be repaired is increasing at the rate of 40% a year.

As proprietor of your own tire repair establishment you will be dealing with the wealthiest and most prominent people in your community. These people will ask you for advice about tires, accessories, even automobiles—unlimited opportunities for profit will be yours.

And you will be in a business which is an absolute necessity to the community. Tire repair trade comes again and again. You will have a steady repeat business getting bigger and bigger every year.

$250 to $500 a Month

With your own Jim Dandy Tire Repair establishment you can make your income $250 to $500 a month or more depending on your energy and initiative. Many tire repair men who have done a business of $250 the first month have increased to $500 the third month. What these men have done you can do. They started like you and learned the business. Their success is not unusual.

Get started in tire repairing with a Jim Dandy plant and get started now. There will never be a better time to start.

Own Your Own Business-Be Independent

WHY depend on another man's business to make a substantial income for you? Why not put your time and ability into your own tire repair business—then you will get all you earn. *You* can be independent just as well as the other men who own Jim Dandy Tire Repair Establishments. These men broke out of the rut, stopped working for somebody else—and started their own tire repair establishments.

We Teach You FREE

You can start a highly profitable business today with a few hundred dollars. One Jim Dandy Plant equips you—we teach you everything about tire repairing—how to start in business—how to get trade—what to charge—how to figure your cash profits. You can learn in one to three weeks—and be ready to make money.

It makes no difference what your present business is. You can make a success of your own tire repair establishment. You don't have to be a mechanic. Neither do you require a college education. Tire repairing is a business man's business. If you have the energy and the will to do, we can teach you in a short time.

We have had forty-one years successful business experience. Since 1879 we have been gathering the information and experience which help you make a quick start today. You understand, of course, that we give you our training and help without charge.

The men who have made big money are the men who have had the foresight and the nerve to break away from the crowd and strike out for themselves when they saw a chance for independence. Don't let a salaried position keep you from *your* chance to own your own business, be your own master, pocket your own profits. Many a "job" has kept a man from a bigger opportunity as an executive in his own business.

Your Opportunity

Haven't you often felt that *you* could manage the business you are in now, if you had the training and opportunity? Haven't you suggestions and ideas which you know would make bigger profits possible? Give yourself a chance to use these ideas where they will pay *you*.

In your *own* tire repair business *you* will have a chance to do the planning and give the instructions. In a short time you can have more work than you can do alone. Then you will have assistants to do the actual work, while you give your time and thought to the active management.

No previous training—no long apprenticeship—no large investment. You can get started immediately—open a shop—and in a short time you have more work than you can handle alone. Good tire repair men are badly needed. Your profits start the day you set up your Jim Dandy Plant.

There is no city too large or town too small for you to do a profitable tire repair business. To every 11 persons in the United States there is an automobile with four tires to be repaired. No matter where you are—what your age or occupation—in ***one month from today*** you can be making money from your own tire repair business if you start ***now***. Let us prove it.

A Jim Dandy Tire Repair Plant makes it easy for you to learn the business and to turn out the kind of work that brings customers back again and again. It is the only tire repair plant on the market which uses superheated steam. Perfect work is assured even when you are a beginner. You can make any kind of a repair—and you buy no unnecessary molds or parts. You do not pay for anything that will not bring returns.

The Jim Dandy has the largest capacity of any plant of its size on the market. It is fully guaranteed and backed by our long experience in the tire repair business. We have established tire repair businesses for men of many ages and professions in towns of 200 population and up and have no record of a failure. We are ready to give you every assistance.

Get The Facts By Return Mail

Investigate. Send the coupon below or a letter or postcard. This brings you full information—personal consideration and advice—and a big catalog. Tells all about the tire repair business. How you can make money—be independent.

By return mail you can have all the facts before you. You might as well make $5000 a year. It is up to you. You know you want it. Then investigate. Use the coupon below.

Scheffer & Rossum Company
Established 1879
St. Paul Minnesota

JIM DANDY
TIRE REPAIR PLANT

TEAR OUT HERE—MAIL TODAY

FREE INFORMATION COUPON

Scheffer & Rossum Company,
175 E. Tenth St., Saint Paul, Minnesota

Gentlemen: Please send full information about how I can start in the tire business with small capital and make a good income. Also your FREE book entitled, "Your Opportunity."

Name .....

Address .....

Six Methods of Automatically Stopping an Engine or Motor

By Windsor Crowell

WHILE there are many schemes for automatically stopping a gas engine or electric motor, the methods here described will be found to serve nearly every practical purpose. They will be found advantageous in cases where the engine cannot be closely watched and tended, as in pumping water at a distance, shutting off when a certain pressure has been reached, etc.

Fig. 1 illustrates the manner in which the sparking circuit can be broken at a certain time of day. It is done in this instance by attaching a cord to the handle of an easy working knife switch and arranging it to be wound up on a drum, which is like the spool that revolves with the winding key of an alarm clock. As the spool revolves with the ringing of the alarm the cord winds up and lifts the switch out of contact.

Fig. 2 shows a gage,—steam, water or air,—with the hand in constant contact with the metallic face. This completes the circuit to the engine. At the maximum pressure however, the hand strikes a spot of non-conducting material and the circuit is broken.

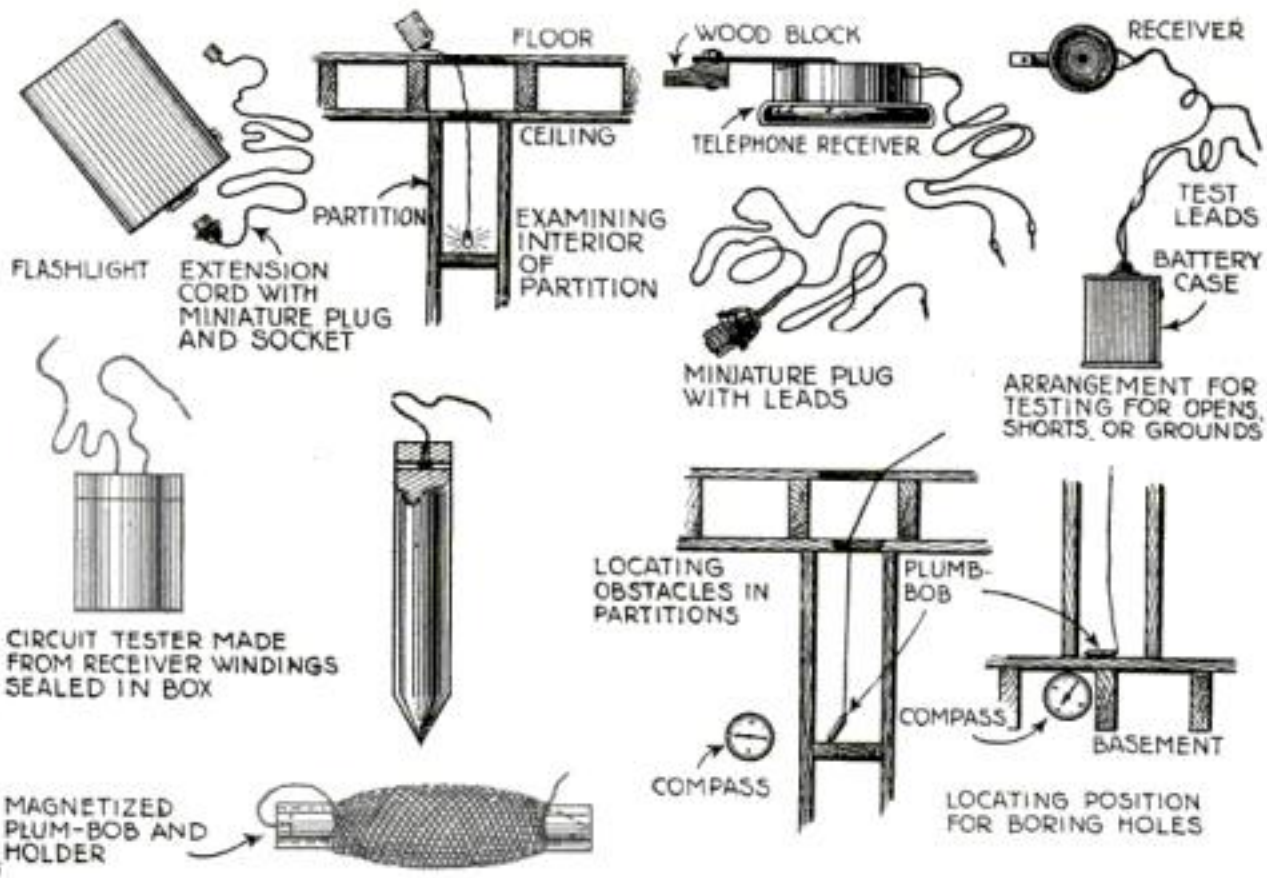
Fig. 3 illustrates a thermostat in the line. Suppose the engine is driving air into a large retort forge or furnace and when the heat reaches a certain degree the blast must cease. Arrange the thermostat so that the points are always in contact as long as the heat remains low. Then as the temperature rises the arm rises until at the proper degree of heat the points separate and the current ceases, stopping the power.

Fig. 4 operates by the action upon selenium. There may be conditions where the engine should be stopped when a certain amount of light is obtained, or at daybreak. Suppose an engine is to be run each night and must be stopped at daybreak. Then a selenium cell is placed in a primary circuit. Selenium, being a poor conductor in the dark, keeps the circuit open until daylight comes in. Then the conductivity changes and the circuit is closed. This, by operating a relay, opens the sparking circuit.

Fig. 5 is a more familiar method and consists of arranging a float in a tank so that when the maximum water level is reached the contact of a switch attached to the float arm is broken, and the engine is stopped.

Fig. 6 is a method of stopping an engine from any distance which can be reached by wireless. An aerial is connected to a relay and battery. In the circuit is placed a coherer. When the key is closed at the sending station, the coherer is induced to close that circuit and the relay operates to open the secondary circuit and the engine stops. This may be increased in efficiency according to the user's demands.

In case an electric motor is to be stopped the controller handle must be held in place by a magnet and when the magnet circuit is opened a spring pulls the motor switch back, out of contact.



There are times when you want to leave your engine or motor to stop automatically. Here are six ways it may be arranged

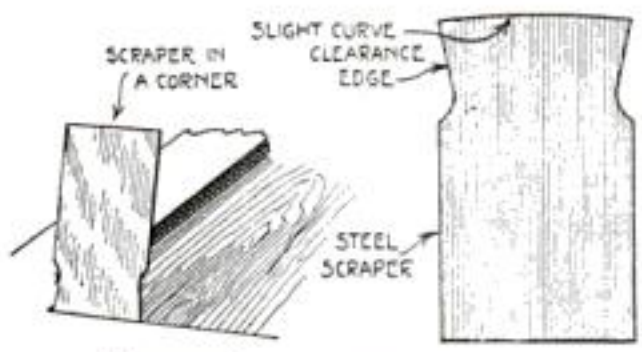
A Scraper Shaped to Work in Square Corners

By Henry Simon

DO you want to save many hours of exasperating work? Then grind at least one of your hand-scrapers as shown in the illustration.

The blade as it comes from the factory has four straight edges. The theory is that any of the four edges may be used. This is a fact, but it is also a fact that no professional woodworker ever uses more than two—namely the two narrow ones—and usually he uses only one of these as soon as he has found out which is the better edge.

On the other hand, the rectangular shape of the blade makes it exceedingly difficult to work into the square corners of paneling and similar places where three surfaces meet at right angles. The edge of the scraper, to work well, must have a slight curve, which makes the outer angles between the sides and the cutting edge more than 90 degrees. For this reason alone it would not fit into the right-angle corners of the panel. But even if the cutting edge of the scraper were kept strictly square, the scraper would not work satisfactorily in such places because even at best there is some lateral movement which is very apt to cause damage to the edges of the stiles or rails if any attempt is made to work close into the corner.



How to shape a scraper so that it will get into square corners

This is exceedingly trying, especially in particular work. Such work is invariably glued, and some of the glue usually works out in the corners and has to be removed. Even if this is not the case, it is usually necessary to scrape good work after it is completed, in order to leave a perfect surface and remove the smudges and marks which are usually in evidence. And nothing spoils the looks of a piece of work more quickly than untidy joints.

Grinding the scraper, as shown here, is the work of a few minutes, and it will then be in shape to handle corner work in a way that is a delight. The full capacity of the scraper's blade is retained.—HENRY SIMON.

Champion

Dependable Spark Plugs

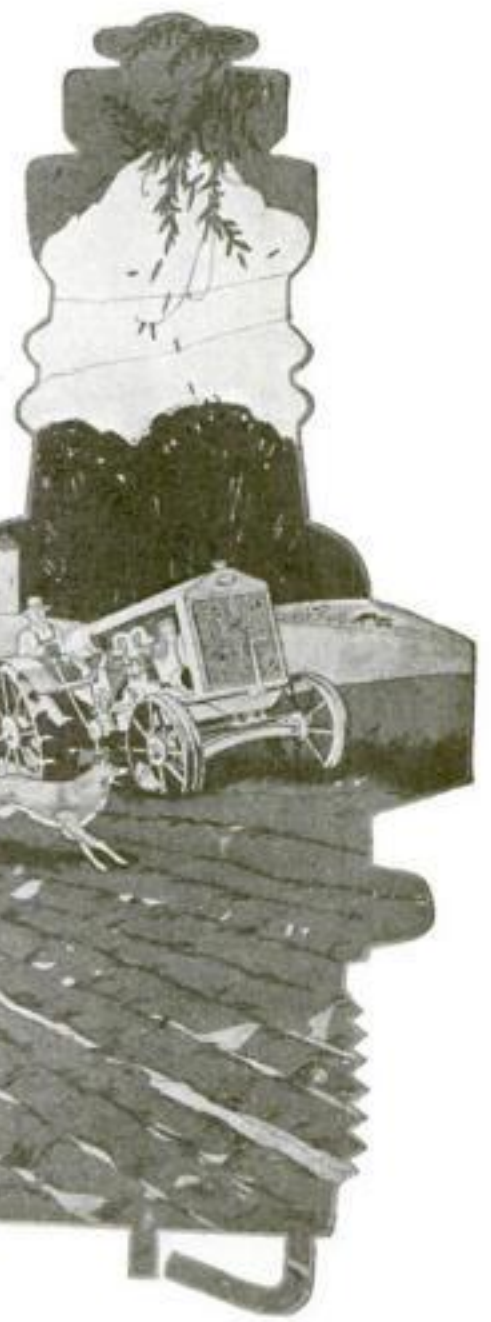
80% Tractor Equipment

WORKING under full load ten to twelve hours at a stretch, the tractor gives spark plugs their most severe test.

Champion Spark Plugs with their famous No. **3450** Insulator are so universally recognised as best adapted to the unusual conditions of shock, heat and temperature changes in tractor service that they have been chosen as factory equipment on **80%** of all tractors being built today.

There is a Champion Spark Plug specially designed for every type of gasoline engine.

Order a set from your dealer now.



Be sure the name Champion is on the Insulator and the World Trade Mark on the Box

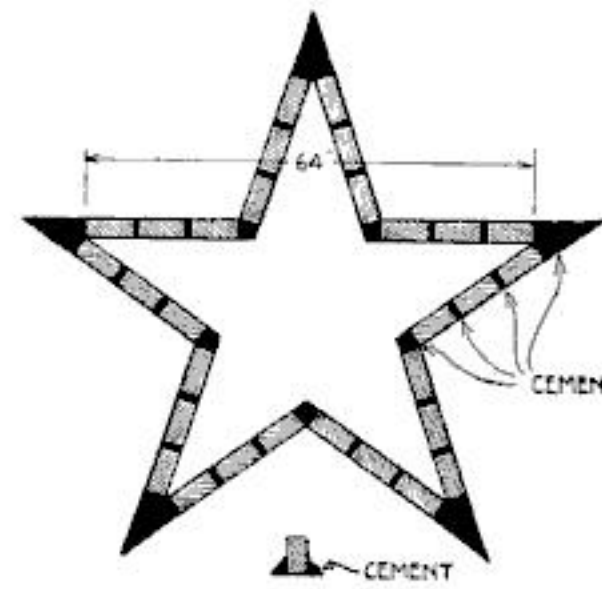
Champion Spark Plug Company, Toledo, Ohio

Champion Spark Plug Company, of Canada, Limited, Windsor, Ontario

To Make a Star-Shaped Flower Bed

THE outline of a flower bed has, of course, as much to do with the appearance of the flowers as the selection and coloring of the flowers themselves.

The illustration shows how a star-shaped bed can be built and outlined



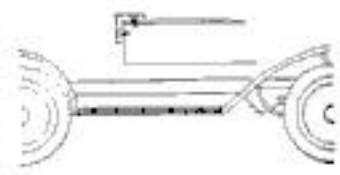
Flowers growing in the frame of a flower bed gain much in beauty. Here is detailed information for making a star-shaped setting that is attractive

with thirty bricks and but very little labor. Five points with six bricks to an arm give a bed of medium and attractive size for the lawn. The bricks are separated a trifle and held with a mixture of cement and sand. When firmly set, the bricks should be given one or two heavy coats of white paint. The bed forms a frame for the outdoor flowers which is pretty when viewed from any angle of approach.—FRANK W. BENTLEY.

An Improvement on the Ford Running-Board

THE appearance of a low-priced car may be greatly improved by putting a brass binding on the outer edge of the running-board. It is a simple thing to do.

Take ordinary angle-brass with the flanges about five eighths of an inch wide, and screw it to the edge of the board, one flange flat on the board and the other vertical on the edge. Fasten it with flat-head brass screws and make the countersinks carefully so the screws will be flush and smooth. Bevel the ends to conform with the angle of the fenders.



Brass binding improves the running-board's appearance

A running-board covering that looks well and will last for at least one season can be made of strips of old heavy linoleum turned with the wrong side up and painted with two or three coats of any desired color.

If the work is carefully done the added bit of trimming will give the car a greatly improved appearance, which will more than repay for the labor expended.—HOWARD GREENE.

Hot towels and finger rubbing not needed with Palmolive Shaving Cream. See this for yourself. Use a trial tube free.

Stays foamy 10 minutes

Palmolive makes a richer, creamier lather than you have ever known. And it stays moist and foamy on the face 10 minutes. You don't have to relather.

A mere bit is ample for a shave. For Palmolive multiplies itself in lather 250 times. There's enough for 152 shaves in the regular size. A cream that is so active, you know, is something new.

Palmolive is also a lotion. It contains palm and olive oils. Thus it soothes and refreshes the skin, and gives a delightful "after feel."

Stop Shaving
the old way

There is no need to use hot towels to soften the beard. Nor to rub the beard. Nor to submit your face to a lather that dries quickly and irritates the skin.

Once such things were considered a necessary evil in shaving. But they are without reason today. For science has found a better way of preparing the beard for the razor. An easier way. And a quicker way.

It lies in the use of Palmolive Shaving Cream. And to show what a big difference it makes in shaving, we are sending a trial tube free to every man who requests it.

Within one minute the beard absorbs 15 per cent of water and the horniest beard becomes wax-like.

Secret of softening the beard

Every hair of the beard is coated with a natural oil. And that oil has been an obstacle in shaving.

The ordinary shaving soap or cream fails to cope effectively with this oil. Thus the beard cannot absorb water enough or quickly enough to make the hair cut easily. That is why men have had to use hot towels and rub the beard with the fingers — to force moisture into the beard.

Palmolive lather maintains its creamy fullness for 10 minutes and thus lubricates the shave.

Palmolive lather instantly **emulsifies** the oil on the beard. Then the beard — a horny substance — quickly absorbs the water. It absorbs 15 per cent of water within one minute after lathering, as proved by laboratory tests. And that makes a wiry beard wax-like.

This achievement alone cost us 18 months of effort. And we tried out 130 formulas.

THE PALMOLIVE COMPANY
Milwaukee U. S. A.

Try it FREE

Note that we are sending a trial tube of Palmolive Shaving Cream to all men who request it. There is no charge of any kind. Take advantage of this free offer. Learn what it means to use a lather that instantly emulsifies the oil-coat on the beard. And a lather that contains both Palm and Olive oils.

Mail coupon for free trial tube. Let your own experience reveal the wonders of Palmolive Shaving Cream.

Send For Free Trial Tube

THE PALMOLIVE COMPANY,
Dept. 116, Milwaukee, U. S. A.

Please send me a free trial tube of Palmolive Shaving Cream.

Name.....

Address.....

When the Thermometer Liquid Separates

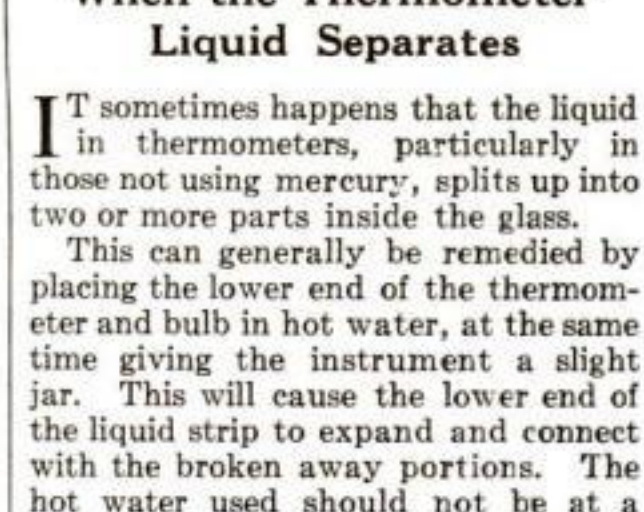
IT sometimes happens that the liquid in thermometers, particularly in those not using mercury, splits up into two or more parts inside the glass.

This can generally be remedied by placing the lower end of the thermometer and bulb in hot water, at the same time giving the instrument a slight jar. This will cause the lower end of the liquid strip to expand and connect with the broken away portions. The hot water used should not be at a higher temperature than the maximum reading of the thermometer.

Winding the Wall Clock from the Floor

A SHORT time ago in a hardware store, I saw the floor manager winding a clock high up on the wall with a flexible winding rod like the one pictured. He had utilized two emergency brake rods from a Ford. One rod was cut off about a foot from a clevis and the sawed end was split up a short distance and driven over the flat clock-key handle and riveted there.

The universal joint which made the rod flexible was constructed as follows. A piece of round rod (metal tubing can be used instead), was fitted loosely between the jaws of the clevis of each rod. Two holes were



Why climb a ladder to wind that wall clock? Do it with an extension winder

drilled opposite each other near one end of the rod. Then two similar holes were drilled at right angles to them in the other end. These were tapped for machine screws. Thus the clevises to the two rods were pivoted to each end of this round rod. The clevis should turn easily about the screw with a little play if possible. The second rod can be made as long as necessary to reach down to the operator, depending of course upon the height of the clock from the floor. Drive a piece of rod, for a handle, through the bottom clevis on the long rod.

By standing at a slight angle from the clock after the key is inserted in the winding hole in the clock the rod will turn easier than if operated at right angles.—L. B. ROBBINS.

WINCHESTER

1866 1920

The Winchester Model 95
High Power Repeating Rifle

WHY YOU CAN TRUST YOUR WINCHESTER

NO matter how critical a test you may put your Winchester Rifle to, it has been put through harder ones for you before leaving the factory.

The barrel must pass the Provisional Proof Test as soon as it is bored. In this it is fired with a powder charge two or three times the normal strength and a bullet one-third heavier than usual.

This is to determine if the steel can stand such abuse without sign of flaw or strain.

Loading, firing, and ejecting are tested just as completely. It must handle and fire standard cartridges in all positions, smoothly and rapidly, or it cannot pass.

Then it is given the Definitive Proof Test, which is officially accepted by the British Government in lieu of any further test. This requires your Winchester to withstand a charge 25 to 40 per cent. more powerful than that for which it is intended.

Following these many shooting tests, your rifle is taken to the range for targeting. Here its sights are set correctly, and it is then required to meet the Winchester test for accuracy—and do it fully and regularly. The firing is at distances up to 200 yards.

Having withstood all these severe tests, your Winchester Rifle then receives the Winchester proof (P W) mark on barrel and receiver — than which there is no higher mark in gunsmithing.

How vital to you to have this Winchester proof mark on your rifle when a hunting climax comes. To have for those few swift seconds a rifle *which you know you can trust.*

For grizzly and Alaskan brown bears, moose, and other large game of great vitality, as well as for long-range shooting at caribou, mountain sheep and goats, above timber, we recommend the Winchester Model 95, shown above. It is the most powerful American sporting rifle. Made in .30 Army, .303 British, .30 Government, .35 Winchester, and .405 Winchester calibers.

Other Winchesters are made in abundance—there is a tested Winchester which you can trust for any game. For deer, we suggest the popular Model 94, of .30, .32 W. S., .32-40, or .38-55 caliber.

Go to your local hardware or sporting-goods store for detailed specifications of the Winchester Rifle and Ammunition you are interested in. If you wish further information, write to us, and mention the kinds of game you intend to hunt.

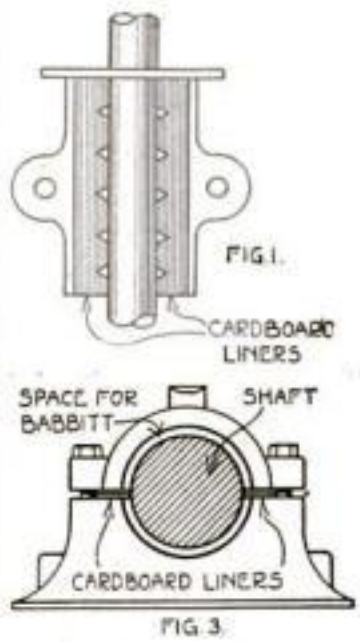
WINCHESTER REPEATING ARMS CO. ··· NEW HAVEN, CONN., U. S. A.

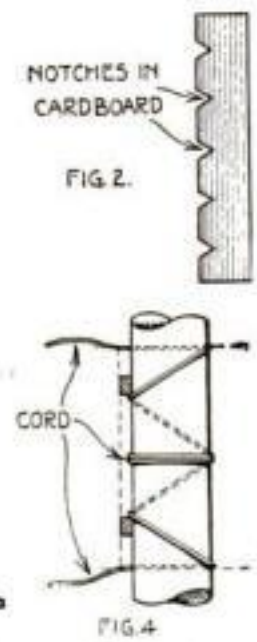
A Quick Way to Babbitt

By R. C. Leibe

THERE are many ways and means of re-lining cast-iron boxes with babbitt metal and the common ways are well known to mechanics; but herewith will be shown a new way which has merit in both speed and perfect fitting.

The common way may be described as babbitting one-half of the bearing at a time; then by means of paste-board liners between the halves, making the other half complete. This





Here is a way to attain speed in babbitting with the assurance of a perfect fit when the bearing is tightened up

method has many drawbacks, such as misfits, and a tendency to twist about.

The "solid" or double poured bearing is not well known to the trade but has many advantages that include good fitting qualities, solidness of bearing, and the absence of space in which the nuts shake loose. It takes half the time required to babbitt the bearings in halves.

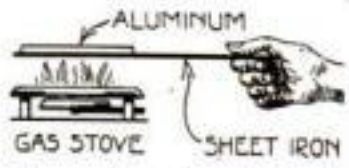
Fig. 1 is an illustration representing the bottom half or base of the bearing with a section of shafting in place, and the "bug" of the process which makes double babbitting possible. This is shown in the notched paste-board liners seen snug up against the shafting. When preparing for this work, take two short leather strips just long enough for the shaft to rest snugly upon and place them in the bearing-shell—one near each end—being sure that their thickness is the same as that of the babbitt metal wanted. Next, place the shaft in bearing on these leather strips and adjust with little leather wedges. Next prepare the pasteboard liners as shown in Fig. 2, and place them on top of the bearing-half edges with notches against the shaft; place the top cap or other half of bearing in place and bolt the bearing together very tightly. Then you are ready to pour the babbitt-metal in the top oil-hole after the ends have been stopped up by means of pasteboard rings to insure smooth ends to the bearing. The arrow in Fig. 1 shows these end stops which are secured by taking a piece of paste-board and hammering it against the end of the shaft until it is cut through, giving a tight fit to the shaft. Clay mud or soap may be used to hold this in place.

When the bearing is full of babbitt-metal, break the halves apart for finishing by inserting the point of a cold-chisel in the slit between the halves, and with a hammer, striking a few light blows. They will break apart easily as nothing holds them but the little metal which has run through the notches in the process of reaching the bottom half of the bearing. When they are thus apart, file off ragged ends of the notches even with edges of the bearing, and after removing the notched liners, insert new liners just twice as thick, bolt up tightly again and place on the shaft. Or, if it should be a stationary shafting of long length, bolt it up less tightly and there will be just enough play to avoid a tight bearing which would result in overheating. All important bearings of high-speed machines which burn out often or are subject to hard wear, should have extra short-length shafts made at a machine shop a trifle larger in diameter, than the one on machine, for babbitting purposes alone as it will give room in the bearing for oil-film without the fatal scraping or wrapping shaft with paper for this effect. It is best not to pour hot babbitt on high-speed or important journals.

Fig. 3 shows an end-view of the bearing bolted up ready to babbitt in the way described. The arrows point to the notched liners in place. The inner circle is the shafting; the space between the shaft and the cast-iron boxing is for the babbitt. Fig. 4 shows the wrapping shaft with a cord to keep the oil in the center of the bearing.

How to Anneal Aluminum without Breaking It

ALUMINUM sheet, like brass and copper, comes in various degrees of hardness, or temper, and the hard sheet is likely to crack if the job calls for much bending. In such a case anneal the metal by heating it in a clean fire until it has reached a very dull red—so that the red shows only when the metal is held in the shadow. The best way to heat a small piece of metal is to place it on a piece of sheet iron held over the fire. This will make it easier to heat uniformly, which is an important consideration.



Even heat is obtained by placing the metal on a piece of sheet iron held over the fire

UNDARK

Radium Luminous Material

"I want that on mine"

The increased usefulness that UNDARK gives to watches it also gives to engine-room gauges. With an UNDARK dial they can be read in the darkest shadow without the aid of a light.

UNDARK on the handles of electric switches prevents fatal mistakes. It makes alarm bell push-buttons always easy to find.

UNDARK doesn't get dark in the dark

It contains real radium and will glow for years.

You want it on safety and machinery control devices in your business. You also want UNDARK on your watch, on clocks in your home, on your motor gasoline gauge, and also on your pull-chain light pendants, electric buttons and door locks.

We are miners and refiners of radium-bearing ore, the pioneer manufacturers of radium luminous material in this country and the largest in the world.

Our service of instruction and inspection encourages the application of UNDARK by manufacturers in their plants

UNDARK is used on numerous articles, to which the following are the most important

Watches	Gasoline Gauges
Clocks	Speedometers
Flashlights	Steam and Pressure Gauges
Pull-Chain Pendants	Revolver Sights
Push-Button Switches	Telephone Mouthpiece
Flip Switches	Fire Extinguishers
Door Bells	Mine Signs
House Numbers	Women's Felt Slippers
Hospital Call Bells	Fish Bait
Ship's Compasses	Theatre Seat Numbers
Locks	Convention Buttons
Safe Combinations	Poison Indicators

Names of the makers of these furnished upon request

Radium Luminous Material Corporation

58 Pine Street, New York City

Factories: Orange, N. J. **Mines: Colorado and Utah**

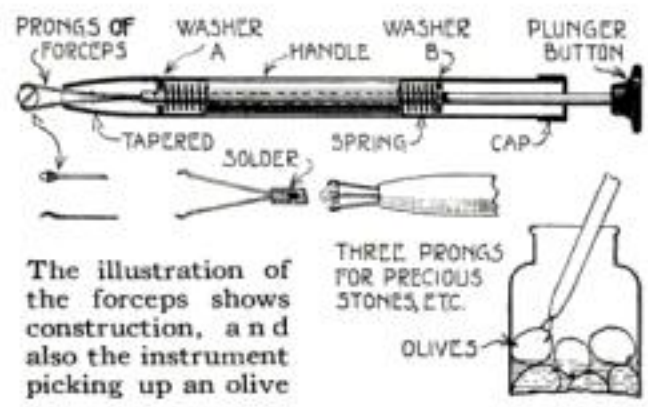
Trade Mark Name UNDARK Reg. Applied For

How to Make a Pair of Automatic Forceps

By Frank W. Harth

ILLUSTRATED by the accompanying diagram is a device which will be found handy for picking up and holding small articles, such as screws, bolts, nuts, etc. It may be constructed from scrap material.

The handle of the instrument can be made from a discarded metal pocket pencil from which the cap and interior have been removed. A discarded stilo fountain pen can also be used. It is essential, however, that the business end be tapered as indicated.



The illustration of the forceps shows construction, and also the instrument picking up an olive

The plunger rod is made in accordance with the diameter of the handle and should be at least 3/32 in. in diameter. The length of the plunger rod should be approximately as shown. The plunger button can be either metal or composition. It should be securely fastened to the plunger rod, by a screw if composition, and by riveting if metal.

The forceps prongs must receive careful attention as the proper working of the instrument depends on them. Spring steel wire about No. 20 gage will prove the most satisfactory. The wire must be stiff and well tempered. The wires are soldered into a previously drilled hole in the end of the plunger rod, the soldering being done when assembling the instrument. The wires should be spread so that they have the appearance shown. The prongs can be of various shapes depending on the commodity to be picked up. The shape illustrated is a good one for general purposes and can be obtained by careful flattening with a hammer.

The spring is made adaptable to the bore of the handle shell and should be strong in its action. Its location is shown between washers *A* and *B*. Washer *A* must fit the bore of the handle shell snugly and is rammed tightly into the tapered end. The hole in the washer should be large enough to permit the plunger to slide through easily. Washer *B* is the same as washer *A* in a general way, with the exception that its outside diameter is a little less than the inside diameter of the handle shell so that it will slide up and down without binding. The hole through the washer must be the proper size so that when the washer is slipped over the plunger rod it will fit tightly. A small amount of solder will hold it securely.

The different parts are now ready for assembling. This is simpler than would at first seem apparent. The spring is dropped into place at the cap end and the plunger rod inserted. To solder the prongs in place the plunger rod is pushed through the tapered part until the drilled end of the rod comes outside. A wooden plug may be jammed into the cap end to hold rod in place while the prongs are being soldered. The work must be clean and smooth so that the rod can slide back again without binding. The cap may then be put in place. If it is of the threaded variety the problem is very simple, but if it is not, a cap must be made from tubing and a washer and soldered into place. The hole through the cap must be large enough to enable the plunger to slide easily. The plunger button is then fastened in position and the instrument is ready for use.

The instrument is simple to use. The button is pressed down and the spread prongs placed over the object to be picked up. As the button is released the plunger is forced up by the spring and the prong wires, being drawn up in the shell of the handle, come together and firmly take hold. To release the object the button is simply pushed down.

Three or more prongs can be used, depending on the thing usually handled. For precious stones a three prong instrument is desirable.

The instrument can also be used for removing the illusive olives from the long and narrow bottles in which they are confined.

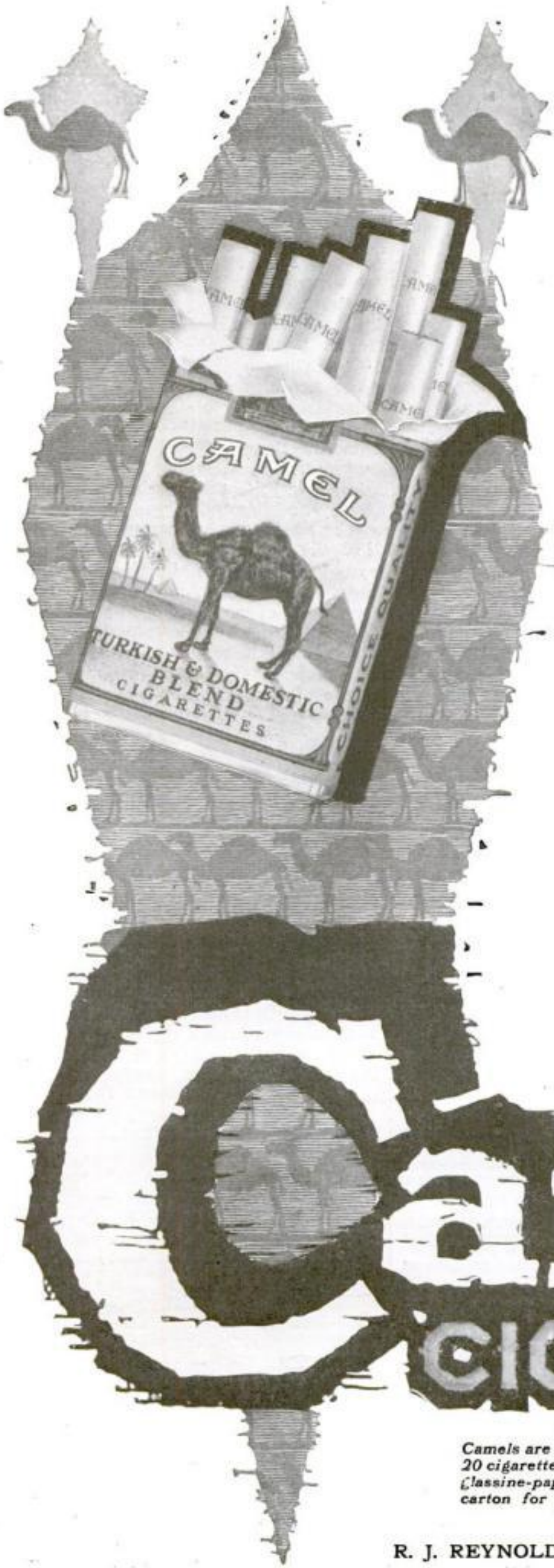
The Curling-Iron as a Kitchen Utensil

THE other day my grocer failed to send the wire key which always accompanies a can of sardines. My guests had already arrived so a substitute had to be found immediately.

There happened to be an old curling-iron in my bureau drawer so I used

When the key of the sardine can was lost luncheon was not delayed. The can was opened with the aid of an old hair curling iron which quickly removed the tin cover

that instead of telephoning for a key. It not only served the purpose, but did the work better than a key does it.—MINNIE ALICE OSBERG.



Man alive—Listen!

You can smoke Camels till the cows come home without tiring your taste!

CAMELS bring to you every joy you ever looked for in a cigarette! They are so new to your taste, so delightful in their mellow mildness and flavor, and so refreshing, you will marvel that so much enjoyment could be put into a cigarette!

To the most fastidious smoker, *Camels are a revelation!*

Camels quality is as unusual as Camels expert blend of choice Turkish and choice Domestic tobaccos which *you will prefer to either kind of tobacco smoked straight!* No matter how liberally you smoke, Camels never will tire your taste!

You will marvel at Camels smooth "body". And, your delight will also be keen when you realize Camels leave no unpleasant cigaretty aftertaste nor unpleasant cigaretty odor! For your own personal proof, compare Camels with any cigarette in the world at any price.

Camel CIGARETTES

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes for 20 cents; or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

R. J. REYNOLDS TOBACCO CO. Winston-Salem, N. C.

Obtaining Speed in a Machine Shop

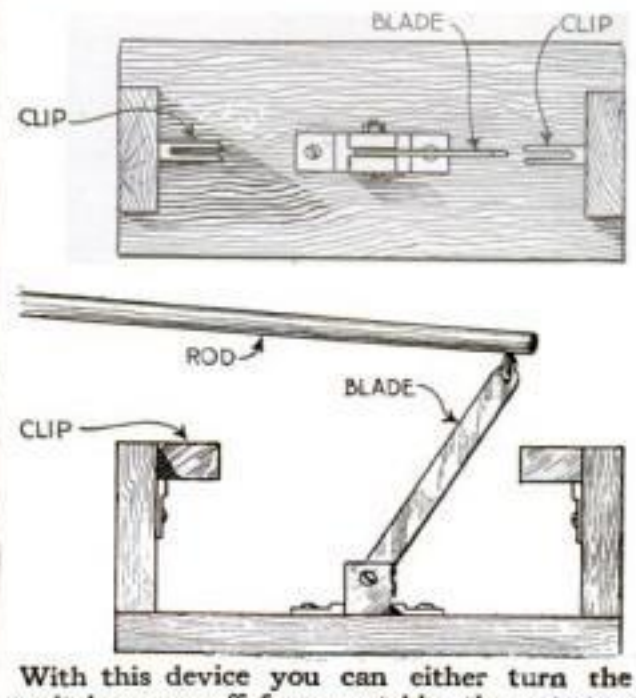
RATHER a complicated piece of work for a thirty-three-seconds' job is shown in the accompanying illustration. It was done in this time, however, and two of the pieces were made in double this time. Many others were made continuously on schedule time. It is wonderful, when you stop to think of it, and yet it is not an unusual thing in some shops. The work is all done by a single machine, and done automatically, including the turning, the boring, the counterboring, reaming, facing, necking and threading.

This complicated piece of work, including the turning, boring, counter boring, facing and threading, was completed in just 33 seconds

The operations are completed practically at the same time. There is no pause, no let up, while the machine turns out the work, moving with the regularity of a swinging pendulum. Other styles of work, equally complicated, can be turned out with equal ease and at very great speed. Some of the big machine companies of the country make special studies of any particular work of this nature which you may wish done automatically. After the study has been made and reported on, a special machine is designed to take care of the several operations involved.—H. C. RIDGELY.

Control the Lighting Switch through the Window

THE underwriters' rules now require a lighting switch, and further that it be on the outside of the building. Opening and shutting the window every time I used my set was some trouble, so I devised the following switch and found it very satisfactory. The diagram shows that it is nothing more than two posts, each having a clip, mounted upon a base, also a



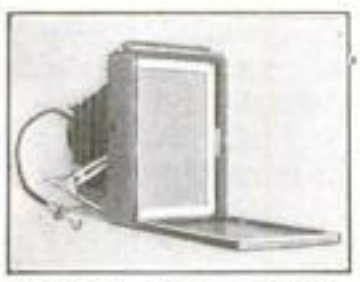
With this device you can either turn the switch on or off from outside the window

blade and its clip mounted on the center of same. A rod was attached to the end of the blade as follows: After a slit was cut between the hole and the end, a screw-eye was inserted and the slit nailed together; then the screw-eye was screwed into the rod. It was then nailed to the window-sill and the rod running through a window-pane.

To make the hole in the window-pane, first place a little mound of clay on the glass and make a hole in it, then pour molten lead into it, thus melting a hole through the glass. Following the same principle, I made another hole for a porcelain tube inserted for the purpose of carrying the wire from the switch to the set.—R. J. HAGERTY.

Use Tracing Cloth to Focus Your Camera

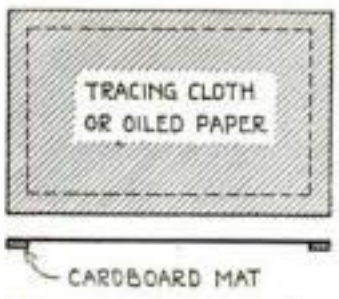
EVERY photographer knows that the only sure way of focusing a picture is by using a ground glass. All other methods are more or less guess work, particularly when the details of an object are to be clearly shown. This can be done with the usual type of plate camera but not with the small swing back type of hand camera such as shown in the illustration. It was to enable the owner of such a small camera to focus it accurately that the screen shown in the diagram was designed.



Instead of a ground glass you can use a piece of tracing-cloth to focus your camera, if it does not use roll film

In this case draftsman's tracing-cloth which is semi-transparent was used but oil paper or a similar transparent material can be just as satisfactorily employed.

Make a mat of cardboard, the outside dimensions of which will fit snugly into the camera back. The inside opening of the mat is made the same size as the finished negative. Paste the cloth or paper over the mat as indicated and set it in the camera. A clip of paper will hold the mat firmly in place.—FRANK W. HARTH.

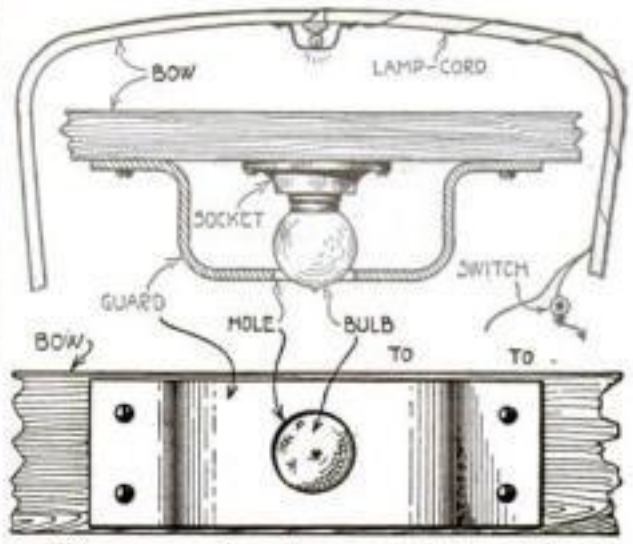


The tracing-cloth is simply pasted over the mat and fitted snugly into the camera

Light the Inside of Your Touring Car

LIMOUSINES have inside illumination. Why not have a light inside a touring car? There are many occasions when a light would be a great convenience for those getting in

or out, and at times it may be a necessity. A small light can be easily installed as the accompanying sketch illustrates. It especially adapts itself



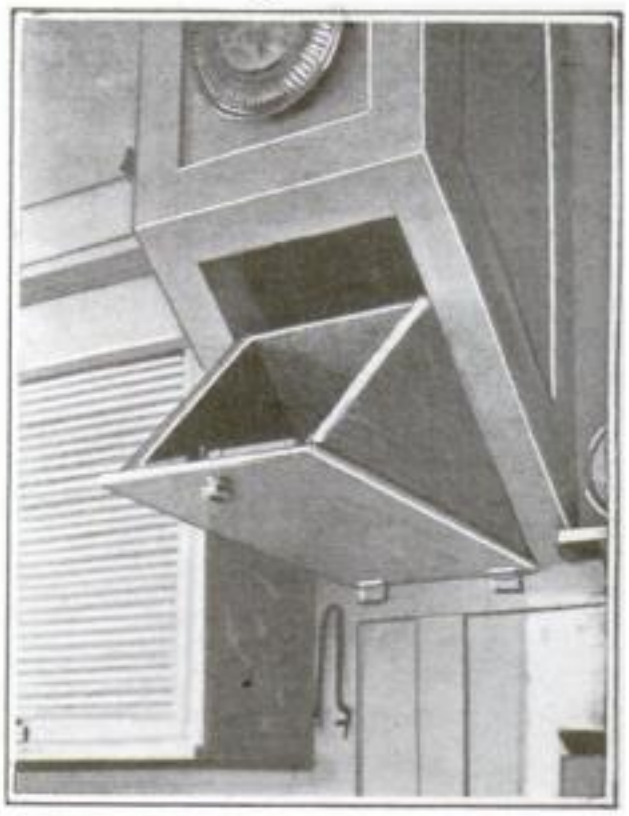
How many times have you lost articles in that dark tonneau? Make a dome light for your car top as here described

to being fastened to one of the bows of the top.

Screw a porcelain socket for a battery lamp to the under surface of this bow, and in the middle. Use about a six-volt lamp of as large candle power as practical and connect it to the magneto in the manner shown.

Then cut out a piece of stiff metal and bend it to straddle the light without quite touching it. Cut as large a hole in the middle as is required to let the light through.

To Make a Space-Saving Cupboard

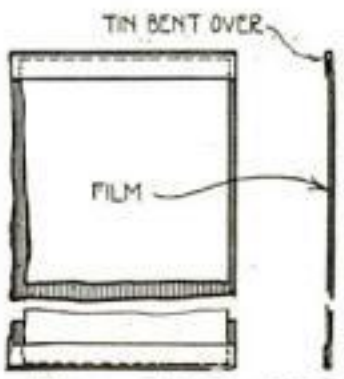


Utilize that waste space beneath the chimney by making a closet to fit into it

IN many kitchens the chimney is not built up from the ground but is supported by a bracket strongly built against the wall. The triangular space under the shelf can be utilized as a cupboard for keeping cloths and brushes for use about the stove. The cupboard is hinged at the bottom and tilts out with a turned wooden knob which embodies a spring catch that locks it in position. Any amateur carpenter can easily construct it from waste pieces of wood.

A Simply Constructed Plate-Holder for Loose Films

IT often happens that one has a few unexposed films in a pack which, under ordinary circumstances, would be thrown away, since they can not be placed in the camera. A special holder for such films can be easily made. It consists of a piece of tin—the back of a film-pack holder will serve this purpose. This is cut ½ in. larger than the film. The two long sides are bent backwards ¼ in. on each side to make it more rigid. The two short sides are each bent forward ¼ in. leaving it slightly loose so that the film can be easily run under these folds without scratching. The film, re-enforced with this tin back, can now be placed in an ordinary plate-holder like any other unexposed negative.—E. BADE.



The metal film-holder suggests a way to use up loose films which would otherwise be discarded as of no use

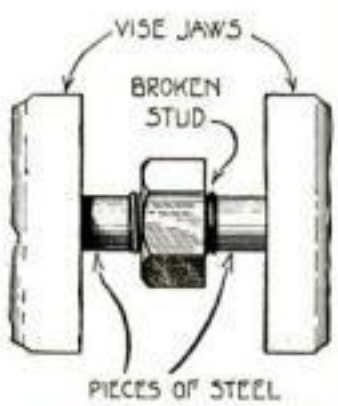
Preventing Matches from Getting Wet

HAVE you ever gone camping, and tried to light a fire with matches that had become damp? Of course you have, and from experience you know that it can't be done. Then why not waterproof your matches so that rain or water cannot injure their firing abilities? Here is the way to do it:

Melt some paraffin in a pan and dip the match head into it. The paraffin makes a waterproof coating over the head of the match and renders it impervious to dampness.

To Remove the Nut from a Broken Bolt

WHEN the end of a bolt or stud breaks off at the nut and you have no other nuts of that size handy, the broken piece can be removed and the nut recovered for use by the method shown in the illustration. Take two pieces of scrap steel slightly smaller than the diameter of the bolt and clamp the broken stud between them in the jaws of a vise. The nut can then be turned off with an ordinary wrench or spanner.

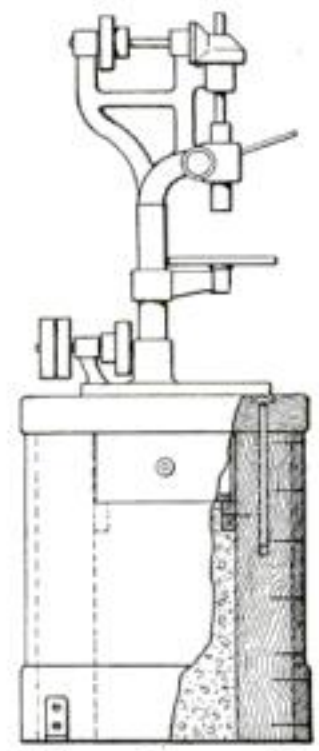


Removing broken bolts from nuts is easy provided you clamp them in a vise as shown above

A Wooden Pedestal for a Bench Machine

By H. H. Parker

A SMALL bench drill-press, or similar machine, could frequently be accommodated to better advantage somewhere else than on the bench. At the same time a regular floor type machine would be too expensive. The illustration shows the construction of a wooden pedestal which is neat in appearance, heavy and substantial and requires little floor space. Standing on the floor, it supports a power driven lever feed "bench" drill-press. The top is made of a heavy plank, between 2 and 3 in. in thickness. Its length and width depend upon the size and shape of the machine base, the weight of the machine and its height from the floor, but these dimensions should be kept as small as possible, while consistent with stability. Four heavy vertical timbers about 4 by 4 are fastened to the top piece by means of long drift bolts driven into them and riveted over clinch rings set in flush with the surface. The corners of the top plank are rounded off and the ends sandpapered smooth. Then the pedestal is planked up with 7/8 or 1 in. boards, the grain running horizontally and two or more widths used, as required. Screws, countersunk and covered by wood plugs, or nails with heads driven in and puttied over, are used as fastenings. A thicker board around the base, say 1¼ in. stock, adds greatly to the appearance of the finished article.



This wooden machine pedestal is neat, and cheap. It takes but little floor space

All the corners are rounded as shown in the plan sectional view, to correspond with the rounded corners of the top piece, and the vertical corner timbers are set in far enough to allow the side planking to narrow in about 1/8 in. all around from the top plank. This, together with the baseboard, makes a very neat finish. One side is cut away enough to allow a drawer to be fitted; this slides on two strips nailed to the corner posts and is convenient for holding drills, wrenches and other small parts. Four iron angle brackets are screwed or bolted at the corners of the wide faces as shown; these are drilled for lag screws or bolts to bolt the machine securely to the floor.

If there is any concrete handy, some may be poured into the pedestal,—enough to be almost even with the bottom of the drawer; this will add weight and cause the machine to operate with more steadiness and less vibration. While an advantage, the use of concrete is not necessary and if it is omitted there will be extra storage space left underneath the drawer.

A couple of coats of dark paint, preferably the same color as the machine itself, will finish the work after all nail holes and cracks are puttied, and one will have practically as good a mounting for his bench machine as if it were of the regular floor pattern.

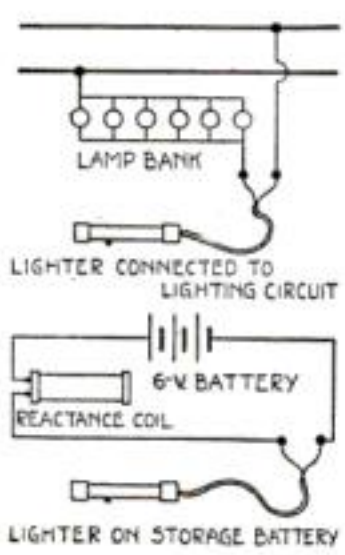
To Make an Electric Cigar Lighter

By Thomas W. Benson

THE cigar lighter described works on the principle of an arc, differing from the usual type in which a coil of wire is heated to the glowing point.

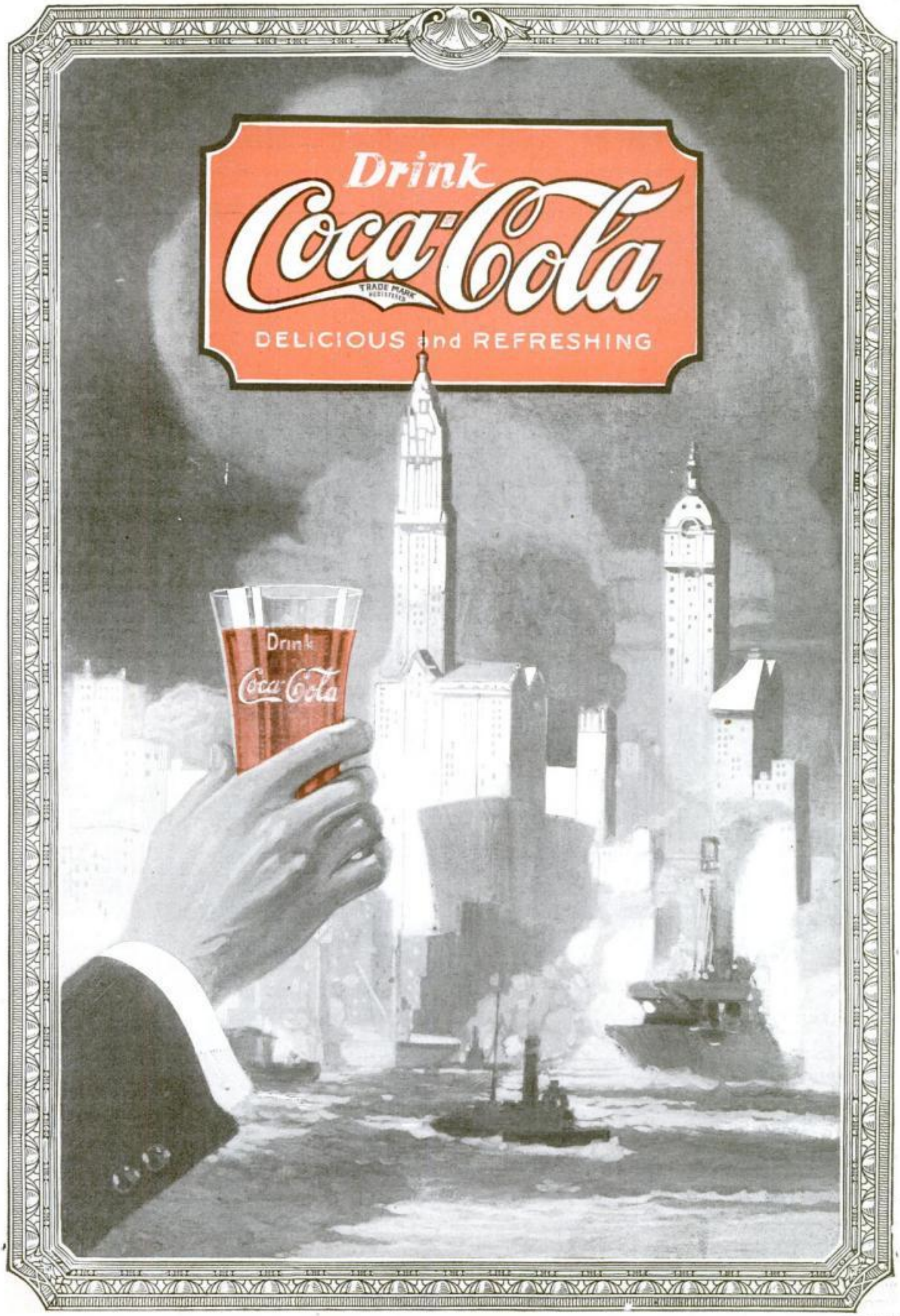
Referring to the large illustration the body of the lighter will be seen. It consists of a fibre shell taken from a large cartridge fuse. Holes are drilled in the brass caps, one to pass the leads and the other to permit the insertion of the tip of the cigar or cigarette. A piece of carbon shaped as shown is mounted near the end having the large hole, by means of a small bolt, one lead being fastened under the head of this bolt.

The other carbon contact is mounted on a strip of brass by binding tightly with fine copper wire. The brass strip is fitted with a short length of fibre rod to act as a push button, the strip then being mounted as shown. The other lead is connected to this brass strip. A narrow strip of friction tape may be wrapped around the casing over the live parts to prevent the hand touching them.



The lighter has few parts and is easy to make. It is connected up in either of two ways shown above

The lighter may then be connected in series with a bank of lamps and operated from the lighting current. It may be used on storage batteries by connecting a gas lighting coil in series with it. Simply pressing the button operates the lighter.



A Bench Anvil Made from a Flatiron

AN old flatiron can be made to serve a good purpose by its conversion into a small bench anvil. A way to do this is shown in Fig. 1. The handle is sawed off and the top

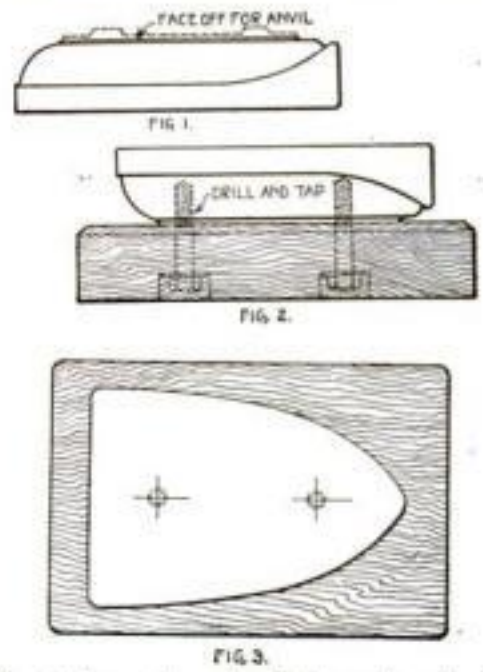


Fig. 1 shows how the flatiron is cut off, Fig. 2 the way it is secured to the back, and Fig. 3 its top surface ready for work

surface smoothed off in a lathe or grinder. A hole may be drilled up through the bottom and tapped for a bolt to hold the casting against the lathe face plate during the facing off process. This forms an anvil with great stability and no other base is necessary; it is merely placed on the bench.

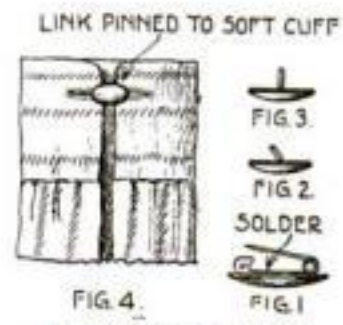
In Fig. 2 and Fig. 3 the bottom surface is used to hammer on and the top is drilled and tapped, after cutting off the handle, for two $\frac{3}{8}$ in. cap screws. A hardwood block is drilled and counterbored for these bolts and for washers under their heads; by means of a socket wrench the anvil is bolted firmly to the base, providing a larger hammering surface than the method of Fig. 1.

In drilling and facing off cast iron of this nature, care should be used, as sometimes there are encountered hard spots which would burn the drill or the lathe tool if too high a speed was used in driving the drill or the work.

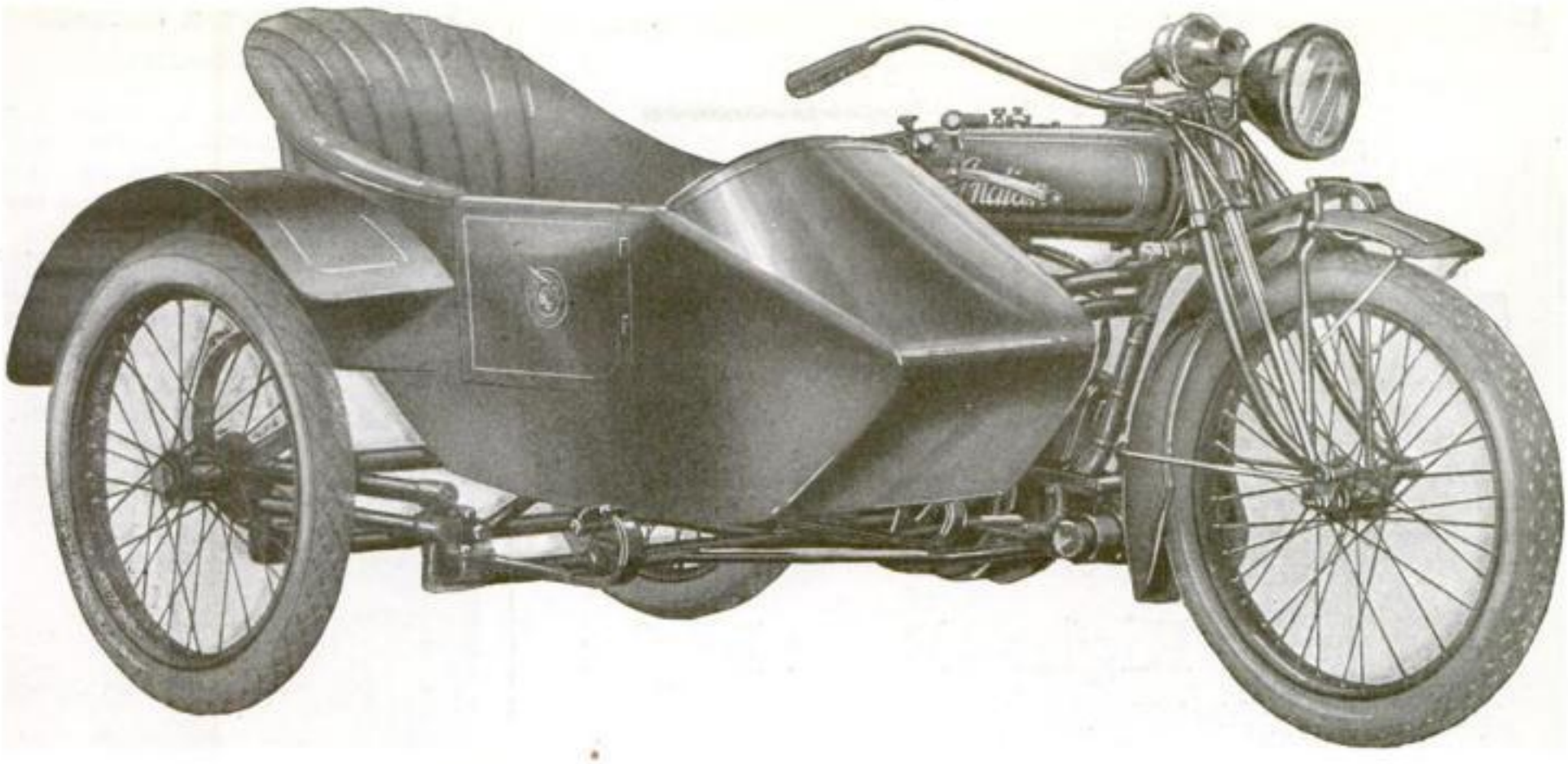
Here's a Way to Utilize Odd Cuff-Links

WHEN a single button of a cuff link is lost the set becomes practically useless. The accompanying illustration shows a method by which the two parts of the remaining cuff button can be used again.

Solder a diminutive safety-pin on the back of each part as in Fig. 1, but don't solder the spring of the pin.—JAMES M. KANE.



Don't throw away that odd cuff link. Solder a safety-pin to it and turn it into a pair



The *Indian* Side Car provides the utmost in comfort

Every refinement of the chassis maker's art has been combined with Indian thoroughness and mechanical mastery to produce the Indian Side Car.

Each detail from the all-important spring equipment down to the folding foot-rest, is expressive of plan and workmanship that produces only the best. And in the design and development of each one of these details, ideal comfort for the passenger was the guiding principle.

The Indian Side Car is worthy of the splendid road-companionship of the Indian Powerplus.

In point of comfort, appearance and roadability, the Indian Side Car, like its powerful comrade, holds a unique place in the automotive field—a place it has won with service-tested merit.

Distinctive *Indian* features

Deep, luxurious, upholstery—two-piece, sheet-metal sections—four sets of resilient springs of chrome silico manganese steel—improved ball bearing hub construction—new clamping attachments for securing wheel spindle—four-point attachment to motorcycle—tool well, floor mat, waterproof apron, self-locking door—these are some of the unusual features of the pre-eminent Indian Side Car.

Department 38

HENDEE MANUFACTURING COMPANY, Springfield, Mass.

The Largest Motorcycle Manufacturer in the World

Indian Motocycle

For Sale by Dealers Everywhere

How to Make a Jazzolin from a Broomstick

THIS instrument is a source of great amusement to the music lover and is one that can be easily played by anyone as it embodies only one string.

Frets or marks may be made at the proper intervals on the fingerboard to guide the novice in placing his fingers. They may be copied from those on a guitar or mandolin or made by finding the scale on the instrument itself.

Here is the way the jazzolin will appear when finished. Anyone can play it with but little practice

The body consists of a small-sized cigar box, the front cover cut as shown in the illustration, measuring 1¾ in. from each corner and 2½ in. down on the sides.

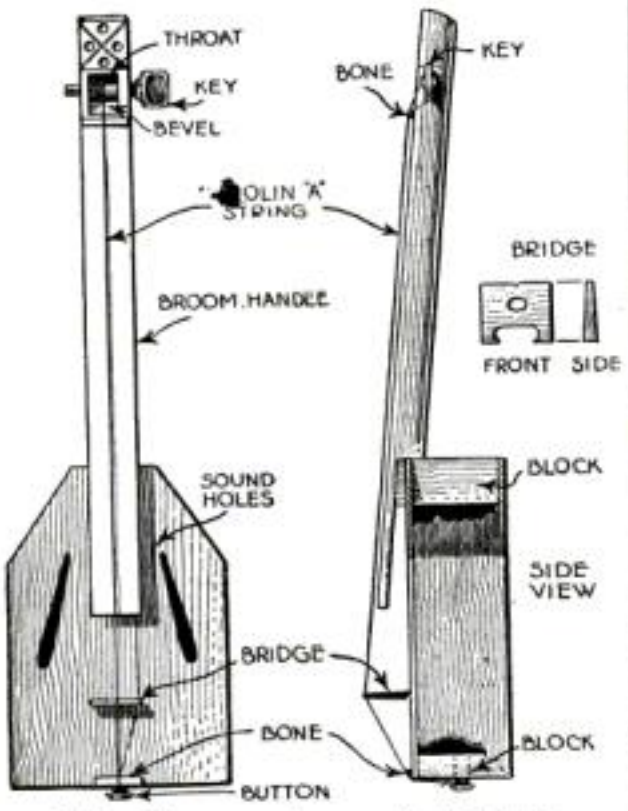
The sound holes are shaped like the warrior club, or the conventional *F* hole may be substituted, the length being 3 in., the width 3/16 in. on one end and widening to 3/8 in. on the other. Set them in or on an angle as shown, 1½ in. in on front and ½ in. on the back. The side view gives the position of the inside blocks—front and back—that in front being 1¼ by 1¼ by 2¼ in. while the back one is ½ by ½ by 1¾ in. The height will vary according to the depth of the box.

Bevel the top of the front block ⅛ of an in. to form the slant for the fingerboard. Bore holes in the back of the block for the button peg. Clamp the broom handle in a vise and plane off the top until the width is a trifle over ½ in. Now measure in 4 in. on one end, and down ¼ in. from the top of the end. Saw on this line to the 4 in. mark, cutting out with a fret saw. The length of the whole will be 15 in. Now measure in 1¾ in. from the other end and drill holes ¾ in. the depth of the handle, 7/16 in. wide and 1¼ in. long. A small strip of bone is fastened upon this end as well as one on the back of the box. These should have small grooves filed in the center of the top for the string. The key is made from hardwood and must taper like a violin key. The design may be varied to suit the ideas of the builder.

The design on the end is made with a three-cornered file and a small drill. The bridge is 1 in. in height and 1¼ in. wide. Cut in ¼ in. on the bottom to form the feet. Taper the thickness of the height from 3/16 in. to ⅛ in.

Make a small peg and insert it in the rear block. Glue strips on the top inside edges and after fastening the fingerboard through the front block set in the top and glue it securely. Now bore a hole through the top of the fingerboard into the block, and countersink the screw which holds it. If desired the bridge may be rounded slightly on top while the two pegs are made for the front and back. This will allow the use of two strings tuned in fifths or five tones between their pitches, preferably *E* and *A* violin strings. Use only silk or gut strings as a steel string will sound much too tinny. Cut the grooves for the strings about 3/8 in. deep—if more than one is to be used. This will allow plenty of drop for the bow.

Purchase a cheap bow from some music store or pawn shop but be sure



The diagram above sets forth in detail every part of the construction and you should encounter no difficulty in making the instrument

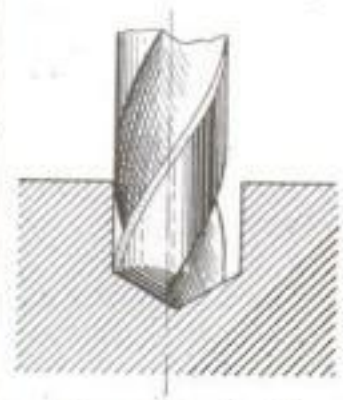
that the hair is in good condition, and it should be kept well rosined. Decorate the edges and corners of the instrument with narrow strips of colored paper and give it two coats of white shellac, rubbing down the fingerboard after each coat.

For a more finished instrument a hole can be bored in the back block under the peg, and in it a round stick about 25 in. in length may be inserted to give a substantial rest for the instrument. When finished this way it resembles the 'cello.

The jazzolin somewhat resembles the ukelele except for the fact that it is played with a violin bow instead of a pick. Several of these instruments in conjunction with a piano will render very pleasing music. The popular "jazz" music becomes easy, once one is accustomed to using the bow.—FRANK W. VROOM.

Grinding a Drill Correctly Is an Art

NO matter how hard the material of a drill, the cutting edges eventually become dull and must be reground. To the novice, this grinding operation may seem a mere matter of holding the tool against a rotating grindstone, but skill is required to sharpen the cutting edges satisfactorily.



The point of this drill is ground off center, so that the hole is larger than the drill

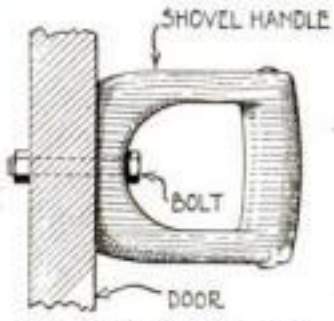
The illustration shows one of the common faults met with in drill grinding. The point of the drill has been ground off center, and as a consequence one lip or cutting edge is longer than the other. A drill ground in this manner will wobble when in use and will make the hole too large. The side of the drill with the longer lip reams the hole, while the other lip runs free, not extending as far as the hole's radius. This fault will be apparent from the illustration.

On account of the liability to error, the hand method is used as little as possible by large machine shops in which work that requires extreme accuracy is done. Tool-grinding machines that adjust themselves automatically are now made. Such machines are as nearly "fool-proof" as they can be made, with the result that the personal errors of the mechanic are almost entirely eliminated.

A Door Handle Made from a Shovel Handle

WHEN you have a door without a knob or handle and a shovel without a blade the two can be made to serve each other.

Saw through the shovel handle just below the rivet under the handle opening. Bore a hole through the remaining portion, as indicated in the drawing, and a similar hole through the door where the handle is wanted. Then bolt the two together with a long carriage bolt and your handle is done. It can be applied to trapdoors and gates as well as doors.



Here is a way to make old shovel handles serve as door-knobs

Does this article suggest other ways of utilizing old tool handles now lying useless in the cellar or about the farm?

How to Prolong the Life of Expensive Shirts

UNDOUBTEDLY the greatest wear in a man's shirt occurs where the stiff lower edges of the starched collar rub the fabric with every movement of the head. Many expensive shirts are discarded prematurely just because of wear and tear around the frontal half of the collar. A practical method by which such shirts worn only in this place may be restored perfectly, is described here.

Remove the worn front panels of shirt by opening seams at front of

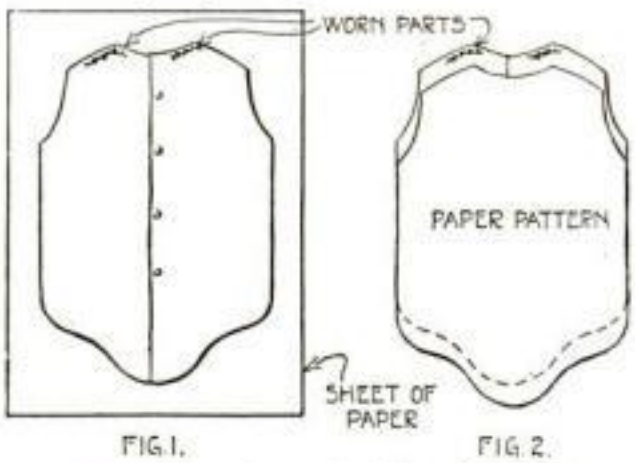


FIG. 1. FIG. 2.

Why discard good shirts simply because they are torn at the neck? Cut off the bad part, move the front up, and the shirt is practically new

collar band, front of shoulders, front of armholes and down the sides. (A discarded safety razor blade serves aptly.) Keeping these worn front panels buttoned, place them on a sheet of paper and trace the outline of the whole shirt front (Fig. 1), then cut out the form for use as pattern. Placing this paper pattern on shirt front, shift pattern downward until worn part of shirt front appears above the pattern (Fig. 2); then trace the pattern anew on the shirt front and cut same to suit, carefully. When this front is sewed back in the shirt, the worn part has been displaced, and the front shirt tails are but slightly shorter, while the shirt is practically new again.—C. NYE.

To Remove Spindle Bolts Easily

WISHING to put in a new set of spindle bolts and bushings in my Ford, I was disagreeably surprised to find that it required an 18-in. pipe wrench, and an old, discarded pump barrel slipped over the end to lengthen it, to unscrew these bolts. Not caring to use these makeshifts again, I procured a small can of flake graphite to which was added enough cylinder oil to form a thick paste; then, when the bushings were fitted and the parts assembled, the threaded ends of the spindle bolts and the threads in the lower part of the axle were coated with this mixture, and the bolts screwed up tight.

Six months later the oil holes in one of the spindle bolts became choked or stopped up and I had no trouble in removing the bolt with the regular wrench used for that purpose.—ROY C. BRADBURY.

This Switch Mechanism Will Prevent Accidents

By Philip G. Bernhotz

TO prevent the recurrence of a serious accident, the switch-interlocking apparatus, shown in Fig. 2, was devised.

Switches *A* and *B* are ammeter-phase switches which must never both be closed at the same time. On the board these switches were arranged without a thought of an interlocking apparatus. They were used for years without serious trouble, because the supply current came only from a 50-kilowatt generator which was too small to cause much trouble when shorted. About a year ago, however, this generator was removed and the switch-board connected directly with the current from a large power-plant. For a time all went smoothly but, when a mistake was made, there was a blinding flash which consumed the switchboard and seriously injured the operator.

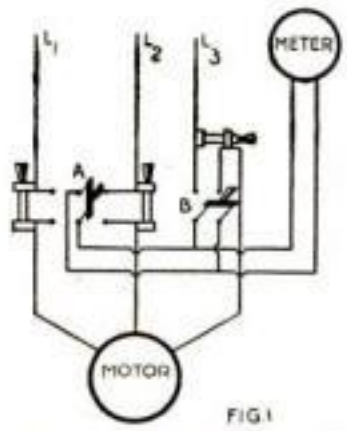


FIG 1

The wiring diagram and switches required for reading the current in a three-phase circuit

Fig. 1 shows the wiring diagram and switches required for reading the current in a three-phase circuit. *A* and *B* are two switches which must be used one at a time in taking the readings, *A* being used for *L*1 and *L*2, and *B* for *L*3. These two switches are shown in Fig. 2 with the interlocking mechanism; *C* is a stick of hardwood shaped as shown in the top view, and held in a neutral position by the spring *D*. Switch *A* has a fiber-block fastened between the blades *E*; it carries an iron bell-shaped lever *F* that engages the end of the stick *C*. The stick *C* is moved to the left, blocking switch *B*. Switch *A* is thrown to the left, stick *C* blocking the switch *B*. When switch *A* is out, the two small springs *D* hold the stick in neutral and switch *B* is free to enter.

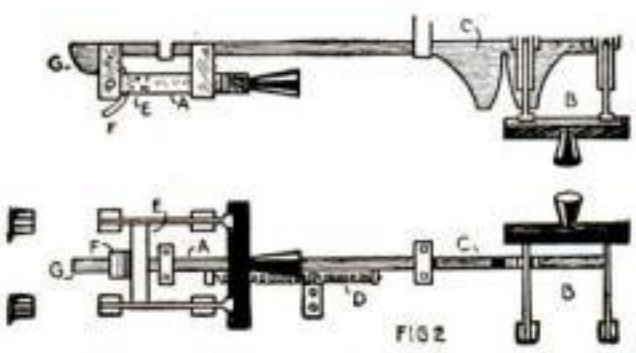


FIG 2

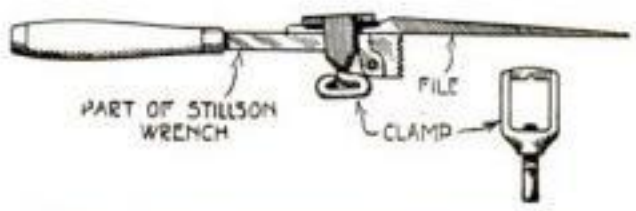
Here are the two switches, together with the interlocking mechanism

G, the curved end of the stick, should be covered with a strip of metal to make it more firm. The notch for switch *B* should be as narrow as possible so as to lock switch *A* as soon as switch *B* enters its seat.

A Simple Way to Make a File More Efficient

A FILE-HOLDER in common use has the disadvantage of being made of cast-iron. When a break occurs, the clamp is usually left intact. Likewise the handle of a small pipe-wrench outlasts the movable jaw, but it goes to the junk-pile with it.

With the unbroken members of the two tools, the file-holder and wrench, the writer constructed a file-holder that was just as convenient as the original one and very much stronger.

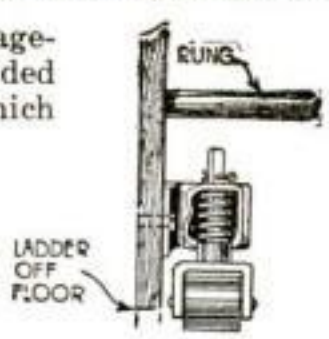


Here is a use for an old broken-down wrench. It now acts as a file-holder and also helps to reduce filing time

The under side of the wrench-handle was filed down as so to accommodate a larger file-tange. The jaw was ground down at the sides and the clamp slipped on and retained with a projecting-pin through the hole in the wrench-jaw. This made an excellent file-holder and one which will outlast a dozen files.—JAMES M. KANE.

A Safety Caster for the Stock-Room Ladder

JIG tool, and pattern storage-rooms are usually provided with 4- and 6-ft. ladders, which often shift when in use, sometimes causing serious falls. The illustration shows a caster that has all the advantages of the roller step-ladder, and that at the same time becomes firm and stationary when a weight is set upon it.

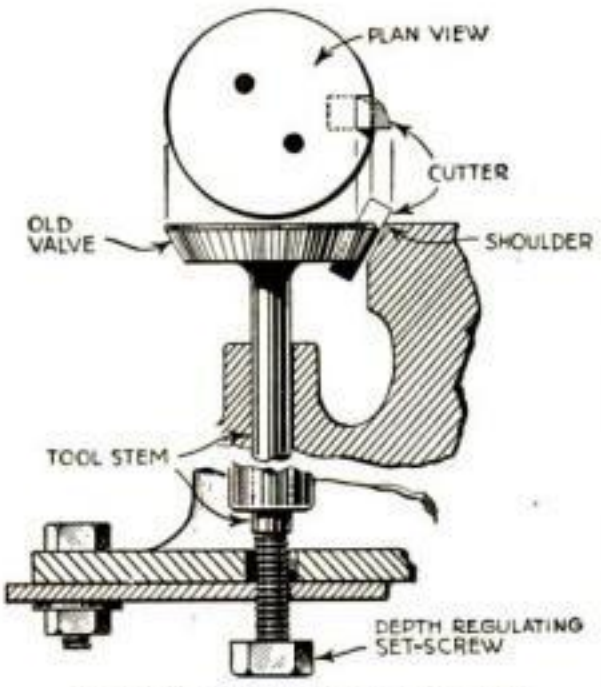


A ladder cannot slip if these casters are attached as shown

The caster housings are fastened to the four legs of the ladder by machine bolts in such a manner that the tension of the springs lift it from the floor. The tension may be adjusted by moving the cotter-pin. The square shank of the caster is compact and close to the side of the ladder and does not interfere with the foot space. Nearly every supply store carries them, and they save their cost many times by preventing accidents.—WILLIAM FARRELL.

To Recut the Valve Seats on an Old Engine

WHEN overhauling an old engine it will generally be found that the valves have worn down their seats, leaving a shoulder around the edge



Why not make your own tool for recutting old valve seats? It will do fine work if turned slowly

which hinders the passage of the gas and also causes the valve to catch and not seat properly.

Make a tool, for cutting down the shoulder and for refacing the valve seat, of an old valve the size used in steel about ½ in. long. Cut a notch in the head of the valve so that the cutter will wedge in tight. The cutter is ground with the cutting edge straight and at the angle shown in the diagram. Then set it in the notch for cutting down the shoulder and refacing the valve seat. A bar of iron bolted to one corner of the cylinder block and with a set screw in the other end directly under the valve guide is to adjust the tool to the proper depth as the seat is gradually cut down.

The tool is turned with a brace and bit and it must be turned slowly, so that it will cut the iron smooth without chattering.—P. P. AVERY.

How to Make a Tapered Rope End

THE proper way to finish a rope end so that it will go easily through an eyelet is shown in the illustration.

To taper a rope end is not a hard problem and to do so will enable a rope to go through an eyelet easily

First untwist two or three inches of the rope and cut the strands to half their present thickness. Then rewind the rope again, keeping each strand well twisted up in the original direction. Then bind up the end as shown.—MORRIS G. MILLER.

The Neatest Mechanical Job I Ever Saw

The Popular Science Monthly will pay ninety dollars for the best answers

WHAT was the neatest mechanical job you ever saw, and how was it done? Some neat ones recently described in the POPULAR SCIENCE MONTHLY were: A broken overhead shaft repaired without removing it. A magneto brush made from an old pencil. Tight pulleys quickly bushed. The action of a drill in soft metal made easy. Worn screws made as good as new. There are, of course, many other neat jobs, and we want to know in how many other practical ways they can be done. Tell us! The POPULAR SCIENCE MONTHLY offers three prizes,—a first prize of $50, a second prize of $25, and a third prize of $15,—to be awarded in accordance with the rules set forth below.

Rules Governing the Contest

(1) Contestants are not limited to the number of neat jobs, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the use of the appliance very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 p. m. on Saturday, July 31, 1920.

(5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and neatest job that you ever saw.

The second prize of $25 will be paid to the contestant who submits a method next in merit.

The third prize of $15 will be paid to the contestant who submits the method third in merit.

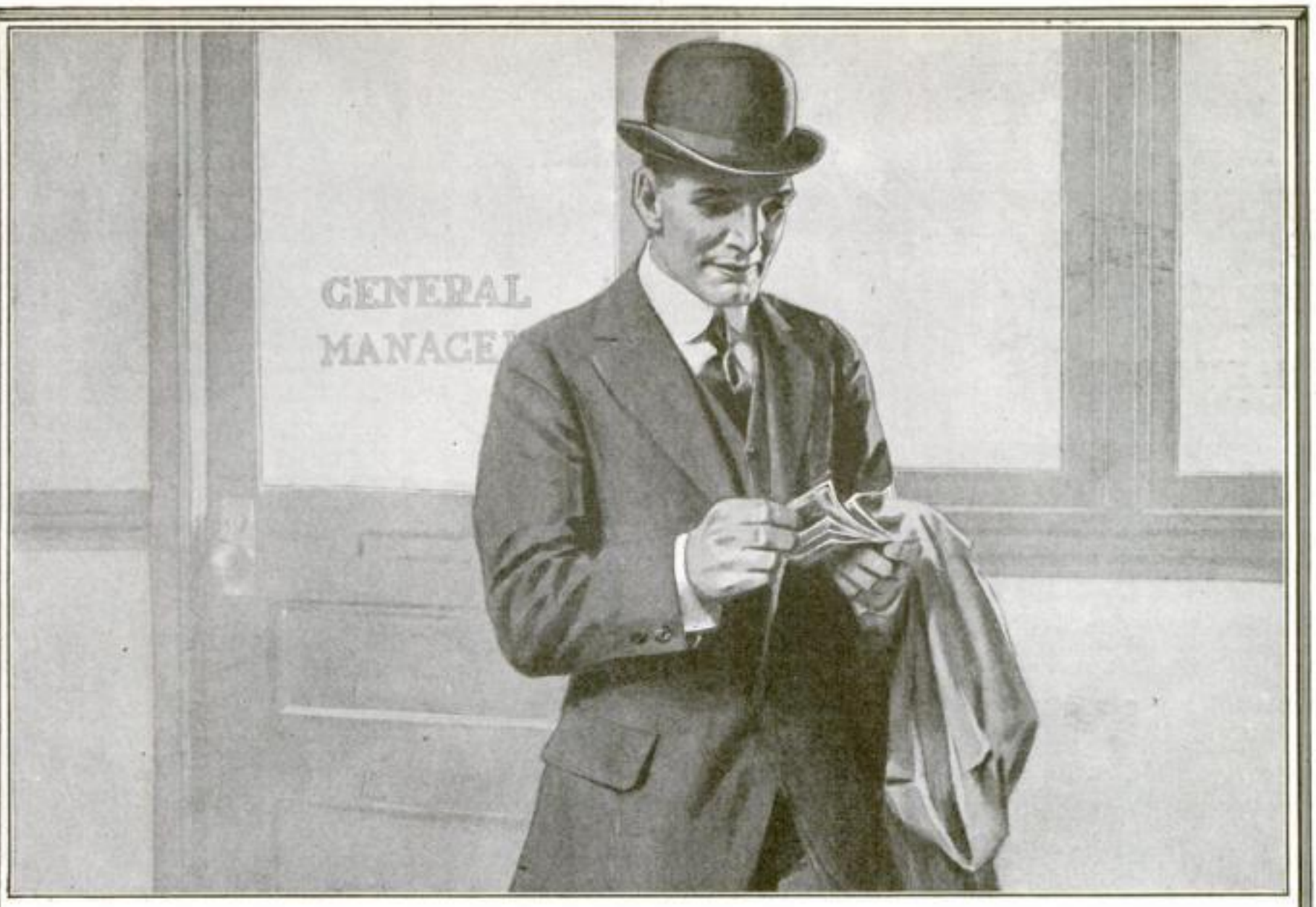
(7) The winners of the contest will be announced in the earliest possible issue of the POPULAR SCIENCE MONTHLY. A description of the methods which win the three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.

(8) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the Neatest Job Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.



"At Last—A *Real* Job and *Real* Money"

"And if only I'd started earlier, I could have had them five years ago. I didn't realize at first what spare time study would do for a man. Taking up that I. C. S. course marked the real beginning of my success. In three months I received my first promotion. But I kept right on studying and I've been climbing ever since."

Every mail brings letters from some of the two million students of the International Correspondence Schools, telling of advancements and increased salaries won through spare time study.

How much longer are *you* going to wait before taking the step that is bound to bring you more money? Isn't it better to start *now* than to wait five years and then realize what the delay has cost you?

One hour after supper each night spent with the I. C. S. in the quiet of your own home will prepare you for the position you want in the work you like best.

Yes, it will! Put it up to us to prove it. Without cost, without obligation, just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7683, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- ☐ ADVERTISING
- ☐ SALESMANSHIP
- ☐ Traffic Management
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ Commercial Law
- ☐ Certified Public Accountant
- ☐ Higher Accounting
- ☐ Railway Accountant
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Good English
- ☐ Window Trimmer
- ☐ Show-Card Writer
- ☐ Sign Painter
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ Mail Carrier
- ☐ CARTOONIST
- ☐ Illustrator
- ☐ Perspective Drawing
- ☐ Carpet Designer
- ☐ Wallpaper Designer
- ☐ Bookcover Designer
- ☐ TEACHER
- ☐ Common School Subjects
- ☐ High School Subjects
- ☐ Mathematics
- ☐ AUTOMOBILE OPERATING
- ☐ Automobile Repairing
- ☐ Auto. Electrical Work
- ☐ ELECTRICAL ENGINEER
- ☐ Electrician
- ☐ Electric Wiring
- ☐ Electric Lighting
- ☐ Electric Car Running
- ☐ Heavy Electric Traction
- ☐ Electrical Draftsman
- ☐ Electric Machine Designer
- ☐ Telegraph Engineer
- ☐ Telephone Work
- ☐ ARCHITECT
- ☐ Architectural Draftsman
- ☐ Contractor and Builder
- ☐ Building Foreman
- ☐ Carpenter
- ☐ Concrete Builder
- ☐ MARINE ENGINEER
- ☐ PLUMBER & STEAM FITTER
- ☐ Heating & Ventilation
- ☐ Plumbing Inspector
- ☐ Foreman Plumber
- ☐ MINE FOREMAN OR ENGINEER
- ☐ Coal Mining
- ☐ Metal Mining
- ☐ Metallurgist or Prospector
- ☐ Assayer
- ☐ TEXTILE OVERSEER OR SUPT.
- ☐ Cotton Manufacturing
- ☐ Woolen Manufacturing
- ☐ Locomotive Engineer
- ☐ Roundhouse Foreman
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Machine Designer
- ☐ Machine Shop Practice
- ☐ Boilermaker or Designer
- ☐ Patternmaker
- ☐ Toolmaker
- ☐ Foundry Work
- ☐ Blacksmith
- ☐ Sheet Metal Worker
- ☐ STEAM ENGINEER
- ☐ Stationary Fireman
- ☐ GAS ENGINE OPERATING
- ☐ Refrigeration Engineer
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ R. R. Constructing
- ☐ Bridge Engineer
- ☐ SHIP DRAFTSMAN
- ☐ Structural Draftsman
- ☐ Structural Engineer
- ☐ Municipal Engineer
- ☐ CHEMIST
- ☐ Analytical Chemist
- ☐ NAVIGATION
- ☐ Motor Boat Engr'g
- ☐ AGRICULTURE
- ☐ Fruit Growing
- ☐ Vegetable Growing
- ☐ Live Stock & Dairying
- ☐ POULTRY RAISER
- ☐ Spanish
- ☐ French
- ☐ Italian

Name_____

Occupation and Employer_____

Street and No._____

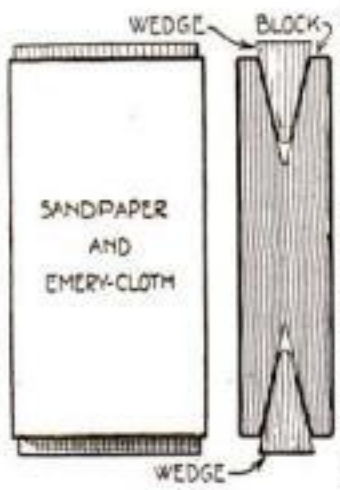
City_____ State_____

7-28-19

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

A Convenient and Effective Knife-Sharpener

FOR several reasons, many electricians consider it useless to carry an oil-stone in their tool-bag. It seldom lasts for any length of time, owing to the abuse to which it is subjected, and moreover, it is not suited to the main purpose for which it is carried, that of keeping the knife in good shape for skinning wires and cutting "loom."



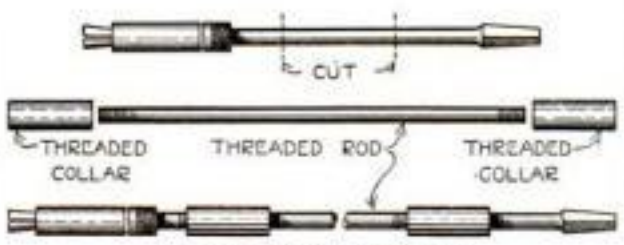
This useful little knife-sharpener for electricians is made from a block of wood

The blade of the knife used in cutting loom gets covered with the substance with which the wire is impregnated and renders the cutting difficult. This is especially true when "weather proof" insulation is being skinned from wires. These substances usually gum up the surface of an oil-stone after one or two sharpenings. The best way to keep a knife in good condition for such uses is first to remove the sticky coating from the blade with a piece of medium sandpaper, then to touch up its edge on a piece of fine emery-cloth.

In the illustration is shown a convenient little substitute for the oil-stone. It consists of a piece of wood-strip about 2 in. wide and 5 or 6 in. long, with a thickness of an inch or so. A wedge-shaped piece is sawed from each end of this block, the wedges thus made being used to stretch a strip of sandpaper tightly on one side and a strip of fine emery-cloth on the other. The abrasive surfaces can be renewed in a jiffy; the device is light and non-breakable and it costs nothing.—JOHN A. WEAVER.

How to Make an Extensible Bit-Extension

THE very fact that a bit-extension is intended to lengthen the reach of an auger-bit often makes it desirable that the extension itself be capable of being extended. While occasions calling for this adjustment are comparatively rare with the ordinary carpenter,



It is the work of a few moments only tom ake the auger-bit extend to any length desired

they are quite frequent with bridge carpenters, well-rig builders, and other mechanics working on heavy construction jobs.

The illustration shows a simple way of accomplishing this result without at all detracting from any desirable quality of the tool. The method consists in simply cutting the stem near the shank and head, threading the cut ends, and re-connecting them with a pair of sleeves made from seamless tubing.

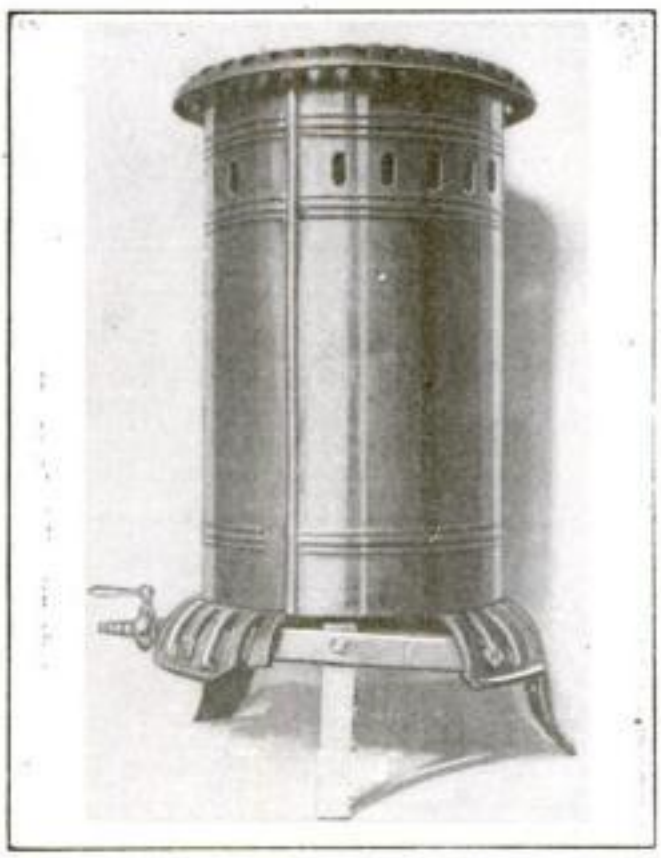
The sleeves should be forced on the threads, on the shank-ends left back of the chuck, and on the square end, so that the only thing necessary to lengthen or shorten the extension is to screw the central section out and the desired section in. The threads can then be set up with a pipe-wrench or in the bench-vise which will prevent any possibility of their coming loose.

Several threaded rods of different lengths may be kept on hand so that the same extension may be lengthened in a few moments from a few inches to several feet.—HENRY SIMON.

Putting the Crippled Gas-Stove Back to Work

BROKEN cast iron is difficult to repair in the ordinary way, and is, as a rule, not worth the expense of a welding operation.

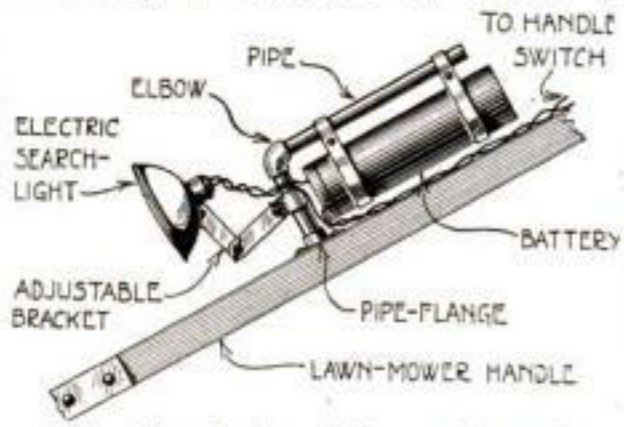
The gas stove shown in the accompanying photograph was broken by a fall, which smashed its foot into small pieces. The foot was replaced by a substantial and lasting repair, which consisted of 5/8-in. strap-iron, as shown. Two pieces of strap-iron were used: one piece served as a cross-bar, and the other as the foot. Three holes were drilled into the cross-bar, one in the center and one at each end. One hole was bored through one end of the foot. The cross-piece and the foot were held together with a short stove-bolt. The cross-bar was then bolted to the openings in the stove with two more short stove-bolts.—FRANK W. HARTH.



Does this gas-stove repair suggest means of restoring to use other broken cast-iron articles?

An Electric Light for the Lawn-Mower

FOR the man who gets home late at night and wants to mow the lawn some sort of a light may be necessary to facilitate his work. A



Why disturb the neighbors with early morning lawnmowing? Attach a light to the machine for evening work

common bicycle searchlight is just the thing and can be attached to the handle of the mower.

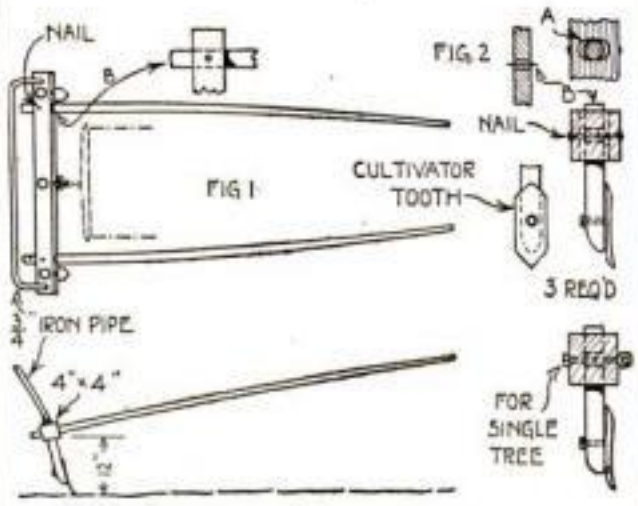
Set a pipe flange on the top surface of the handle about half way up. Screw a 6 inch nipple into that and an elbow on the top of the nipple, pointing back towards the end of the handle. Then set a horizontal piece of pipe in the elbow about 12 in. long.

The light bracket can be attached to the upright nipple and the battery can be suspended from the horizontal piece, as on a bicycle frame. The switch can be carried up to the cross handle at the top. By setting this arrangement fairly high on the handle all flying grass will go under the light and not interfere with its illumination. —L. B. ROBBINS.

A Device for Distributing Potatoes and Corn Evenly

A SIMPLE marker to be used for spacing rows for corn, potatoes, etc., can be made from parts found around the average farm. The diagram shows the construction in detail.

The cross-bar *A* is made from a stick of wood 4 in. by 4 in. To take



Make from cast-off parts found around the farm, this homemade potato- and corn-row marker does excellent work

the shafts 2-in. holes are drilled at *B* These shafts can be made from young trees, for these have the necessary taper and are much more flexible than straight sticks. A large nail,

driven as shown, will hold each shaft in place. Strap-iron braces, screwed to the shafts and cross-bar, will serve to hold the contrivance rigid and prevent side-sway.

Three markers are used, one serving as a guide and the other two to mark new rows. Old cultivator-teeth are bolted to lengths of wood 2 in. in diameter. The distance from the bottom of the teeth to the center of the cross-bar should be about 12 in.

To prevent the marker from jumping out of its course or being broken by striking stones, etc., the holes *A* should be made longer than they are wide. This will permit a certain amount of play and will leave the tooth-holders rigid.

The two outside markers are fastened in the same way as are the shafts; that is, with a large nail, as is shown in Fig. 2. The hole through *B* should be a trifle larger than the nail so that there will be sufficient play to permit the piece holding the teeth to move back and forth in the hole *A*.

The central marker is fastened with an eye-bolt instead of a nail. The single tree chain is fastened to this eye-bolt. The guide-bar, which is used for keeping the marker in its course and lifting it over obstacles, is a ¾-in. pipe, bent to shape and then tightly jammed into the holes.

This Cement Saw-Buck Promotes Efficiency

CEMENT has many advantages over wood in the construction of a saw-buck, or block for holding logs while sawing them into stove lengths.

This substance is heavy enough to stand solidly under all stresses, it never

The usual saw-buck is made of wood and the whole contrivance is as a rule rickety. Here is one that will clamp the log firmly

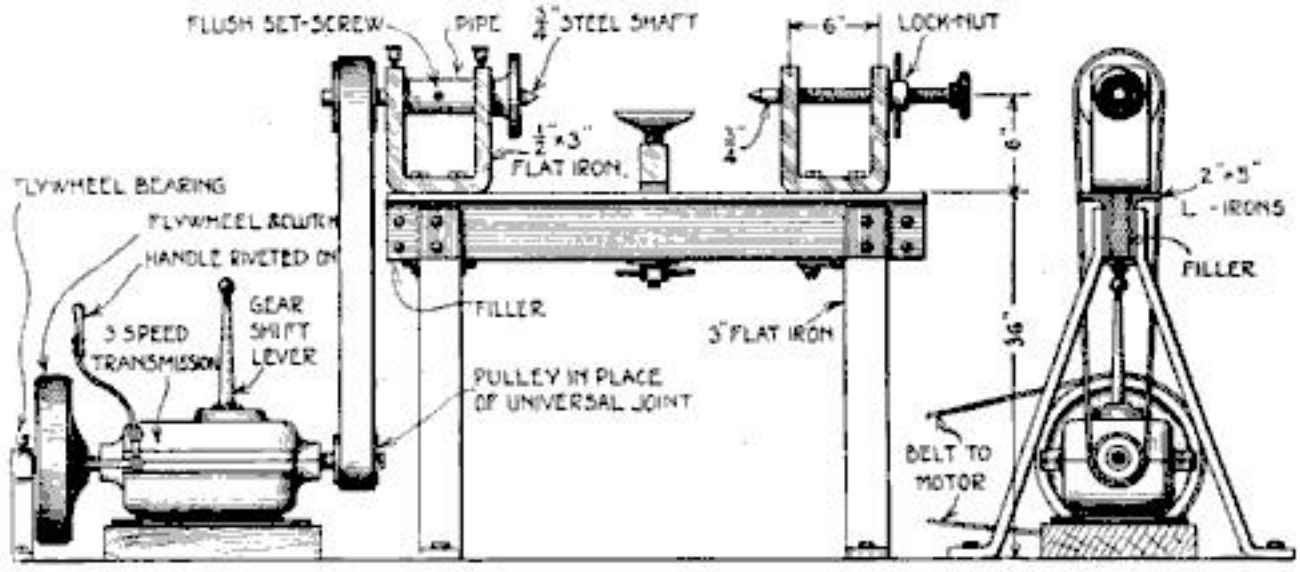
wears out, and it is neat and attractive.

The form for casting is merely a rectangular box that can be easily dismantled. The triangular groove in the top of the finished contrivance is produced by nailing two short pieces of wide board together to form a V-trough, and laying it in place when casting. Two stout metal rings should be attached to rods or wires, and these rods or wires should be imbedded in the cement, near the top, two on each side. The rings are very handy for fastenting straps or chains for holding the log solidly to the block. Use a cement mixture of 1 part cement, 2 or 3 parts sand and 3 parts gravel or large pebbles.—JAMES P. LEWIS.

A Lathe with a Change Speed Power Plant

By P. P. Avery

A VERY serviceable and accurate lathe may be built of scrap parts, and a novel means of speed change may be obtained from an old automobile transmission and engine flywheel. The lathe is made from two pieces of *L* iron, 2 by 5 in. for the bed frame with the legs of ½ by 3 in. flat iron bent, drilled and cut as shown.



Besides an old automobile transmission for the various speeds necessary, pieces of scrap iron were used to make this lathe

Place filler pieces at each end to separate the two members of the bed frame, using hard maple wood or cast iron of 1½ in. thickness by 3 in. wide and 5 in. high. These fillers are held in place by ⅜ in. bolts and double lock nuts, with the bolt end riveted over. The chuck and tail bearing *U* pieces are formed of ½ by 3 in flat iron, the chuck end being securely and permanently bolted in place, while the tail is movable for adjusting to any distance along the bed. The wot bolts in each bearing are ⅝ in. and pass through a filler guide of $1^{15}/_{32}$ in. thickness. A ¼ by 3 in. plate washer on the bottom makes a steady draw-up adjustment. Thread through both sides of the tail and make a ¾ in. rod with a tempered center point and *T* handle.

The chuck bearing is fitted with a shaft and filler made from pipe which has a thrust and is held in place with a key and safety set screw. The pulley on the end is connected by a 3 in. face leather belt to a pulley of the same diameter on the tail shaft which is, in this case, the shaft projecting from an old automobile transmission. The illustration shows every part in detail and the amateur should have no trouble in assembling the various components. The clutch pedal is fitted with a strip of ¼ by 1½ in. flat iron bent as a handle and, of course, the old gear shift lever can still be used without changing it.

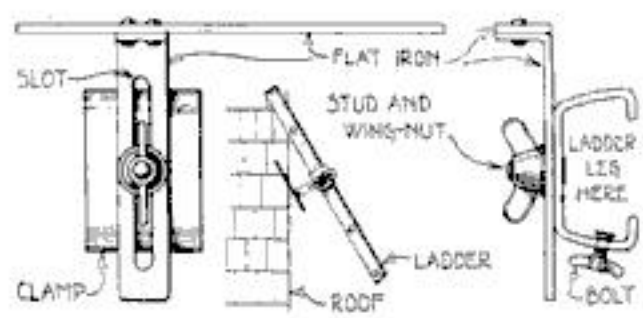
The operation is as follows. Pull forward on the clutch lever which will disengage the clutch and change the gears to the desired ratio with the other hand on the gear shift lever. This keeps the motor always normal and gives three varying speeds to the lathe as required. The gears may be changed without closing down the motor.

Steadying a Ladder Against a Slanting Roof

A LADDER placed against the gable edge of a slanting roof is always wabbly and dangerous. To overcome this is an attachment which fits the ladder and can be adjusted to meet the height and pitch of the roof where the ladder touches.

A loose clamp is made in the shape shown, and fitted around one leg of the ladder, where it will slide up and down. It is tightened in place by a bolt. This bolt has a flat surface on the bottom which bears against the ladder.

A hole is then drilled through the middle of the clamp and a stud riveted through it. This extends out about an inch. Then a flat piece is constructed to fit down over the stud and slide over it a short distance each way, by means of a slot. One end of the slotted piece is turned out at right angles and riveted to a second piece used to bear against the edge of the roof. This arrangement is held in place on the clamp by a wing nut.

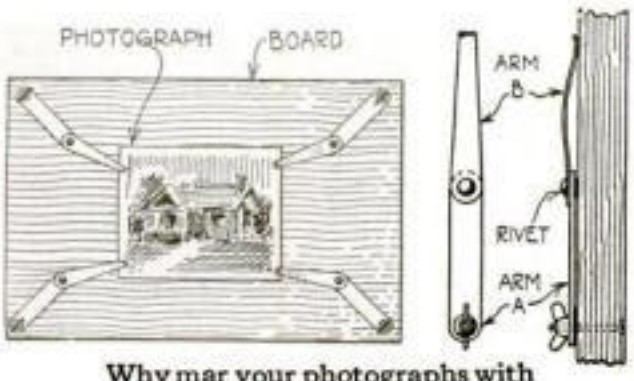


Have you ever tried to climb a wabbly ladder? Here is an extension which will hold the ladder rigid at any angle at which it is placed

By sliding the clamp along the ladder to the desired height and adjusting the slotted piece the right distance from the gable edge, the worker will be assured of a steady ladder.—L. B. Robbins.

Clip for Holding Photos and Drawings

THE usual method of holding drawings or photos for copying is by fastening them with thumb tacks or similar means to a board. The device illustrated will not mar



Why mar your photographs with thumb tack holes when spring arms will hold them just as well?

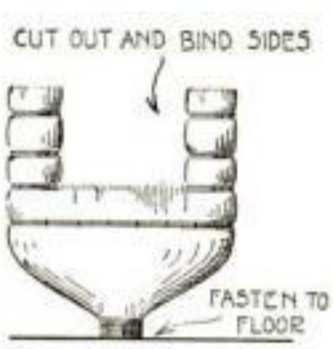
the drawing as would a thumb tack and will hold it firmly in any position. It is composed of two arms, one arm inflexible and the other springy. The curved end of the springy arm rests on the drawing and holds it in place. The two arms may be swung in any position.

As four devices are required, all the parts can be multiplied by four. For the arm *A* take a piece of strap brass ¾ in. by 1/16 in. thick, and 4 in. long. Drill two holes in each end. The hole in one end is for a fulcrum rivet of arm *B*. Make the arm *B* from 1/32 in. spring brass and shaped as shown. The rivet should be tight enough so that the arm *B* will not swing loosely.—F. W. HARTH.

When a Broom Is a Shoe-Cleaner

WHEN the bootblack is charging ten cents plus the tax of a healthy "tip" for each pair of shoes cleaned and polished, why not duplicate the example of J. H. Vaughan, of Texas, who has found economical use of a discarded broom as a shoe and boot cleaner? Of course, the handmade device is not capable of administering the shining fluid but a thorough cleaning of the leather is the big end of the job.

So uncover that frazzled broom long sequestered in some corner, eliminate the straws and strings by cutting, as illustrated by the accompanying diagram, and make a notch sufficiently large for your foot to form intimate companionship therewith. Saw the handle off to a convenient length to insert in a hole in the steps or porch of your home. After dispensing with the straw, the sides are compactly laced.—S. R. WINTERS.

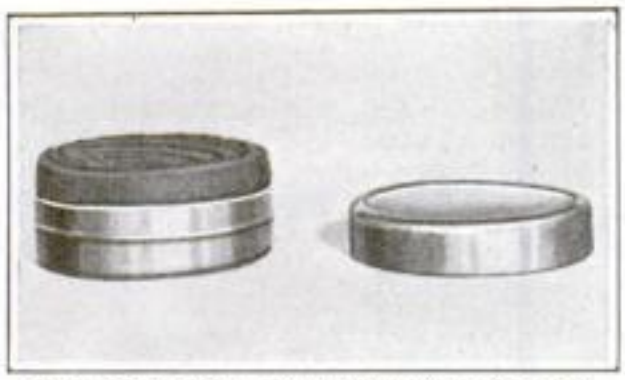


Cut the broom in the manner shown above, insert it in a hole in the front steps and it is a shoe cleaner

How the Mechanic Can Keep His Tools Bright

THE machinist or other metal-worker who uses steel rules, squares, bevel-protractors and other instruments that are graduated in inches and fractions, finds that they soon acquire a slight coating of rust upon their surfaces, which makes it difficult to read the markings. The rust is caused by perspiration of the hands, as well as by dampness in places where the tools may be laid away while the artisan is working in mill or factory. The method of keeping tools bright adopted by machinists, is to polish them frequently by means of oil and an old piece of emery-cloth, kept especially for the purpose. The tools are scoured from time to time, as is judged necessary.

The graduations on these articles being snallow, it is not long before the tool is rendered useless by having its markings wear away as well as its edges and corners wear around. As an "ounce of prevention is worth a pound of cure;" the writer devised the simple appliance illustrated, which



The illustration shows the oiler with the cover off, and the box with its roll of felt in position, ready for immediate use

has given satisfactory service for over fourteen years.

To construct one of these oilers, obtain a lacquered tin ointment-box of $2\frac{7}{16}$ in. in diameter and $\frac{5}{8}$ in. depth (measured without the cover on). It can be bought for a few cents from a druggist. Also get a five-cent jar of vaseline. From a dry-goods store procure $10\frac{1}{4}$ ft. of red felt, if your box has the diameter mentioned; if it is smaller, it will require less of the felt. This material should be $\frac{7}{8}$ in. wide. Spread a newspaper on the floor and rub the vaseline on both sides of the felt, then roll it up tight so that it will make a snug fit in the box. Put a pin through it to hold the roll together while it is being placed in the box. It is then ready for use. Lubricating oil can be used in place of vaseline if desired, but most oils contain a trace of acid which, small as it is, darkens the surface of the tools. Vaseline, being derived from petroleum, keeps the surfaces bright and free from rust.

To use the appliance, take the cover off and rub the greased felt on all sides of the tool. Do this every day before going home from work. Your instruments will always be bright, rendering the taking of measurements easier as well as resulting in greater efficiency

by saving time. Keep the cover on the box to exclude dust when it is not in use.

Should a person possess a rule or square that has been allowed to accumulate much rust, chemical means may be necessary to remove it. Heat 1 qt. of distilled water and dissolve in it a quantity of chloride of tin in small portions. As fast as it dissolves, add more, shaking the bottle each time, until the water will not dissolve any more. This is called a "saturated" solution. Place the rusty rule in a dish filled with the solution, and allow it to remain over night. Then remove it, rinse it carefully in water, wipe it dry with a cloth, and the job is done. The rule will be a silvery-white color. Grease it with the oiler to keep it in condition. The tin solution should be poured back into the bottle.—W. S. STANDIFORD.

When the Motor-Truck Engine Balked

ONE cool morning a certain farmer accompanied by his son was bowling merrily over the road with a good-sized motor-truck load of produce he was taking to a city market. They came to a fairly steep hill and started up when the engine suddenly began to sputter and miss, and finally balked. Surprised, for not five minutes before he had negotiated a much steeper grade, the farmer threw out his clutch and allowing the engine to idle, backed slowly to the foot of the hill and tried again. This time the engine acted as before, only the farmer was not quick enough at releasing his clutch and the motor stalled. He floated to the bottom of the hill again where both he and his son got out and looked the engine over.

"Acts as though the gasoline might be low," remarked the son.

"It couldn't be," replied the father, "unless there's a leak somewhere, for I filled the tank before we left home."

Nevertheless, they went carefully over the gasoline feed system but no leaks could they find. The carburetor was next examined to see if it was clogged by dirt or foreign matter and to make sure it was getting a full supply of gasoline, but no trouble of any kind could they locate. Examination showed that the ignition system was apparently in good order. They then cranked the engine and after a few preliminary snorts it began to run evenly.

Again they started up the hill, this time the son standing on the running board to the better observe the action of the engine. It worked fairly smoothly until the grade became steeper when, as before, it began to pop and miss, and then balked altogether. They backed to the bottom of the hill more puzzled than ever. A friendly truck driver came along, asked what the trouble was, and they explained.

"Looks like your carburetor might be out of order," he suggested.

"It couldn't be," stoutly defended the son, who had studied its adjustment. "That make of carburetor doesn't suddenly get out of order. Why, five minutes ago it worked perfectly, didn't it, father?"

"Yes, coming up Pepper's hill it couldn't have worked better," his father confirmed.

The truck driver was unconvinced, but after examining the carburetor acknowledged he was unfamiliar with that make or its adjustment. Then feeling he could be of no further help, he drove on.

The truck driver's reference to the carburetor set the son to thinking and he remarked to his father as they were starting up the hill again and the engine began to repeat its previous performance, "It acts just like it does when it's cold, before it gets thoroughly warmed up."

As the engine continued to balk, he got out, lifted the hood and felt the carburetor.

"Why, it's cold," he exclaimed excitedly. He gingerly felt of the hot air intake feed pipe and found that this also was cold. The scent was growing warm, and following the hot air pipe to the heater on the exhaust pipe, he discovered it had jarred or shaken loose at the connection, leaving an opening so that cold air could enter, consequently no heated air was delivered to the carburetor.

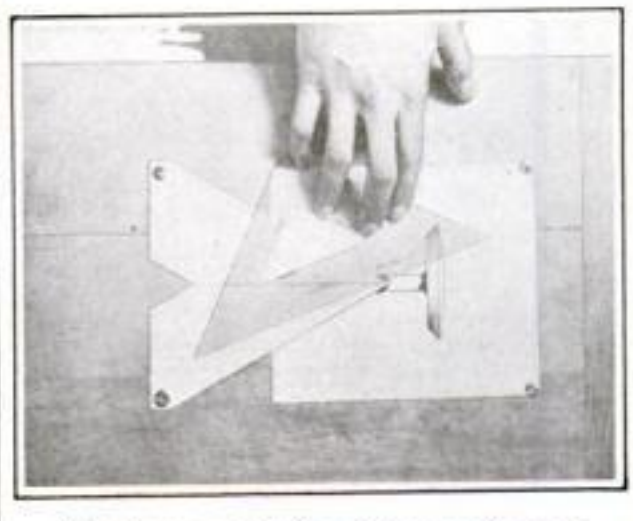
"There's the trouble, I'll bet," he said.

Reconnecting the separated parts was the work of a few moments. Then after allowing the engine to run a few minutes, or until thoroughly warm they mounted the hill with ease.

All of which proves that "hot air" is a very necessary element to the successful operation of a loaded motor-truck on a cool morning, especially in these days.—ED. HENRY.

How to Make a Draftsman's Centering Instrument

A HANDY draftsman's center that will not injure the drawing is illustrated in the accompanying picture. It is simple, and can be made



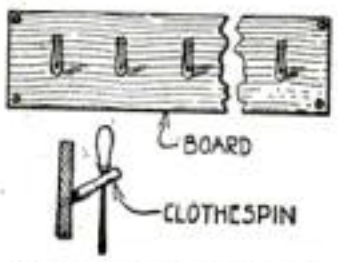
Why buy a centering instrument when you can make one from material on hand

in a minute or two of time. A triangular shaped piece of heavy paper or bristol-board is used and a notch is cut on a previously drawn center line. The center line is used to line up the device with a T-square and the other notch is used to center the device on a center line of the drawing underneath.

Near the end of the cardboard triangle on the center line carefully push a thumb tack through from the other side. Place the thumb tack head down on the drawing, having first drawn pencil lines to show where the radiating lines intersect, and either locate with the eye or test with a triangle.

Clothes-Pins Arranged to Serve as a Tool-Rack

TO keep the small tools hung up and out of the way is not always an easy problem but if you can find some old clothes-pins and a board, a rack for holding tools like screw-drivers, files, chisels, etc., can be quickly made, and will prove a handy asset for the work shop.



Clothes-pins with their heads cut off and set in a board make an excellent tool-rack

Cut off the heads of the clothes-pins as close to the end as possible. Then mark a straight line along the middle of the board and bore holes along it, slanting slightly downward. Into these the ends of the clothes-pins should fit tightly. Smear the clothes-pins with glue and force them into the holes. When they are dry, fasten the rack over the bench and the small tools will always have a place.

An Old Film Will Make an Excellent Duplicator

AN old photographic plate or film, either exposed or unexposed, will make an excellent duplicating device capable of making twenty to thirty copies of typewritten or hand-written originals.

Obtain an old plate or film and soak it for several minutes in lukewarm water. Then lay on a flat surface and remove the excess water by using several pieces of newspaper as a blotter. When the surface has become sticky so the paper peals off, then lay the previously prepared copy face down on the plate and smooth it gently by rubbing the back with your hand. Allow it to stay on for about a minute and then remove it.

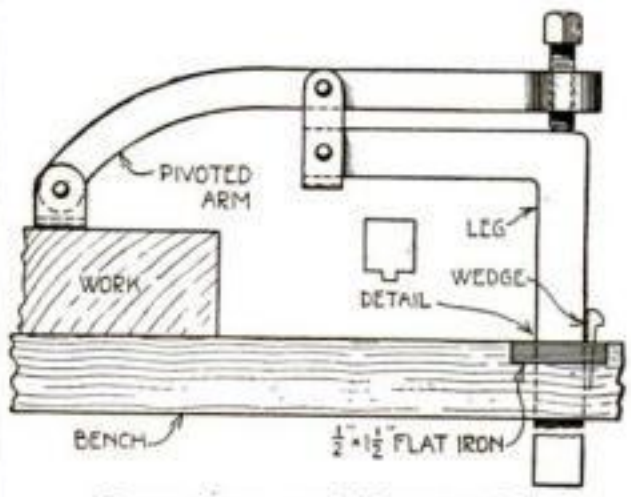
Blank pieces of paper are now laid on, smoothed out, and immediately peeled off. These will be found to have a perfect copy of the original.

It is impractical to remove the old copy to make another as the ink eats through the film.—VICTOR H. TODD.

A Bench-Clamp for the Amateur Carpenter

THE bench-clamp is a simple tool to make, yet it is a very excellent device. It is made from odd bar stock; the old square axle of a light buggy furnishes excellent material.

The leg is bent at right angles. The



If you have an old buggy-axle lying around, you can turn it into a useful bench-clamp

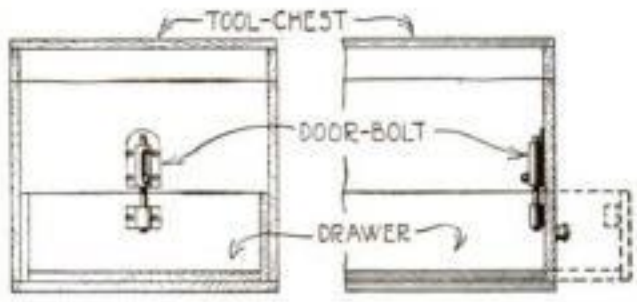
section passing through the bench is 2 ft. long, and the section to which the U-piece is riveted is 10 in. The U-shaped piece is made of ½ by 1-in. iron.

The pivoted arm is forged from a piece of the axle into the shape shown. The strip of iron set into the plank on the bench is a piece of ½- by 1½-in. iron obtained from an old heavy wagon wheel tire. This strip is fitted up to take the clamp at various parts of the bench. The square holes are made by drilling a hole, filing it square, and then filing a key-way for the taper-wedge key. By prying up the key, the clamp is quickly adjusted for any height and by a light blow upon the key, it is secured.—C. H. WILLEY.

How to Lock Your Tool-Box Securely

THE accompanying illustration shows a combination lock for a tool-box provided with a drawer. A door-bolt here takes the place of a second lock.

The door-latch is screwed to the inside wall of the tool-box, the bolt passing through a hole in the bottom

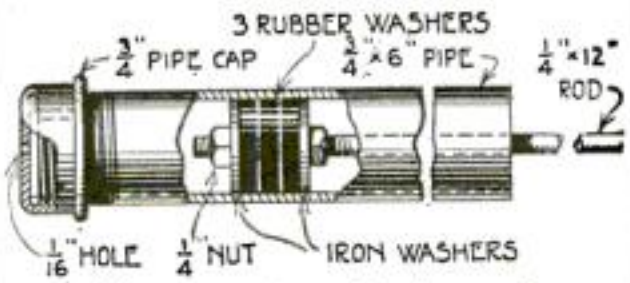


Tools can be stolen from the drawer of your tool-box. Why not give it a lock too?

of the base. To lock the box, the bolt is first anchored, holding the drawer firmly fastened from the inside, then the tool box is locked by the key in the usual way.—ERNEST SCHWARTZ.

An Inexpensive Typewriter Cleaner

WHEN the typewriter keys begin to work with difficulty, it is a sure sign that the old oil on the delicate bearings of the type bars has become gummy, and no amount of re-oiling will do any good; unless, of course, the bearings are first thoroughly cleaned. To do this easily and without dismanteling the machine, construct a cleaner of the simple squirt-gun type, as shown in the cut. It is made as follows. Procure a ¾ in. by 6 in. pipe nipple, wrap a piece of fine sandpaper around a round file, and thoroughly clean the inside of the pipe of all scale; next get a ¾ in. pipe cap into the center of which drill a 1/16 in. hole.



When your typewriter keys get dirty and begin to work with difficulty this home-made gasoline squirt-gun will clean them

Screw this tightly on one end of the nipple. You now have the barrel of the pump made, and you can proceed with the plunger. From a piece of ¼ in. rod cut a piece 12 in. long, form a hand-grip at one end as shown, thread the other end for a distance of about 1 in. and screw down a ¼ in. nut, place a ¼ in. washer on this end and on the washer place three washers cut from sheet rubber or leather; put on the other ¼ in. iron washer and nut, tension the soft washers by screwing down this nut till the plunger fits tightly in the barrel.

Having strained some gasoline through a piece of chamois skin or old felt hat—to be sure that no water is in it—and having placed the typewriter out in the yard, or out in the open far removed from any flame—push the plunger to the bottom of the barrel and submerge it in the gasoline; then draw it up and squirt with a hard, quick push, which will throw a fine, hard stream against the type-bar and other bearings. Allow the machine to dry about five minutes, and oil it thoroughly. To do this you will need a piece of very small copper wire about 8 in. long; form a loop at one end 1 in. in diameter, flatten the other end for about an eighth of an inch; pour a little oil into a saucer, or some other clean receptacle, dip the flattened end of the wire into this. A small quantity of oil will adhere to the point, and apply this to the various bearings.

Wrap both these utensils in a clean cloth and put them away for future use—you will never want to be without them after once using them, for they will be found invaluable for this kind of work.—ROY C. BRADBURY.

Forest Trees Come to Aid of Radio Men

The forest ranger has a valuable ally in the new radio-telephone

LAST year, the Federal Forest Service thoroughly tested the radio-telephone in the western national forests, and ascertained that under average conditions in those regions, the wireless method of communication

Packing wireless telephone equipment into the mountains. When the trail gets too steep for the mule the rangers carry the equipment

was more satisfactory and much cheaper than the installation and operation of the ordinary telephone system. For example, two complete wireless stations were installed with a talking range of 60 miles, for $3,000. This included the power plant and all accessories. A telephone system of similar character and length would have cost over $5,000 at that time. The radio-telephone is easily installed and is simple to operate as soon as the rangers become familiar with its technique. In one instance several months after a certain set was placed, two green hands who previously had been uninformed about wireless telephony were able to expertly take and send messages.

At each set two suitable trees are cleared of boughs and branches and wires are stretched between them to serve as antenna. The storage batteries and other equipment are usually placed in a tent which is reserved as the communication center of the camp. The communication area to each set has ranged anywhere from 10 to 300 miles, the average distance from the set where portable outfits are used being about 50 miles. During the current year 42 sets have been established at various points in the national forests of Wyoming, Montana and Oregon. With great labor, the storage batteries and other equipment have been packed into the mountains on the backs of forest rangers. At the present time a recently invented gasoline engine is being used for re-charging the batteries at some of the camps, thereby reducing much of the hand labor formerly necessary in conveying the dead batteries from camp to town.

Last year the War Department, through its flying schools in Southern California aided the Forest Service representatives in patrolling national forests in the Golden State in the fire location work. This season the work will be continued and extended into northern Wyoming, Idaho, and Montana. Twenty forest rangers are now attending ground schools at one of the army camps in order to become familiar with the flying activities so that in their ground work in cooperation with the airplane patrol service they can render efficient service. It is planned to utilize the radio-telephone as a means of communication between

Showing how a forest ranger operates his radio-telephone

the airplane patrols and the rangers below to facilitate the transmission of information about fire outbreaks. Suggestions now before Congress are that the 154,000,000 acres of national forests be henceforward policed by flying machines. It is estimated that 90 planes would be required for such service and that the annual saving in valuable timber and grazing land would more than pay expenses.

The foregoing shows how the wireless telephone is invading the forests of America. The other important applications of radiotelephony must not, however, be lost sight of in the natural

Two tree-tops are cleared of limbs and the antenna wires strung between them

He is receiving the first wireless telephone message ever sent in national forests

interest of new developments. As examples we may mention its uses for ordinary ship-to-ship and ship-to-shore business traffic, for communication with long-distance railway trains, and in lighthouses for assisting ship navigation in fog. We are on the threshold of great developments in this direction.

Two Radio Records

TWO long-distance radio records are arousing special interest among operators of low-powered stations. They were made by the sister ships *Colombia* and *Venezuela*, of the Pacific Mail Steamship Company, while on their way home from Asia, working with the Inglewood Navy Radio Station which is located near Los Angeles. Each ship was equipped with a 2-kilowatt radio set.

Inglewood has two towers, 325 feet high, and is equipped with a 12-kilowatt federal arc apparatus.

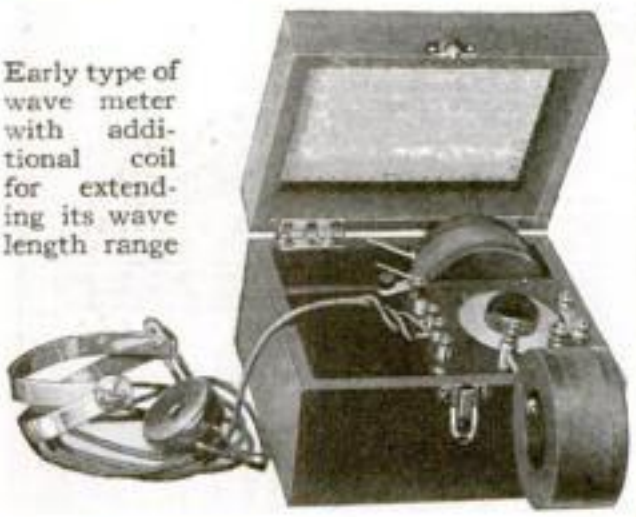
When the *Colombia* was 4,100 miles from our coast she first got in communication with the Inglewood Station.

For a real long-distance radio record for low-powered stations, however, the Inglewood operators and those on the *Venezuela* deserve the palm. On November 11 the *Venezuela*, about seventy miles out from Yokohama and 5,900 miles from the Inglewood Station, got through to the Inglewood Station and exchanged a number of messages. Radio experts say this is the record for low-powered stations.

A 2-kw. set is ordinarily good for a maximum distance of 400 miles during the day and 1,000 miles at night. The remarkable distance covered by the *Venezuela* 2-kw. set would appear to indicate that a new type of equipment was involved, but this has not been stated.—J. W. K.

What's Happening to the Amateur's Decrement?

THE answer to this question is that his decrement is vanishing. Many amateurs are now using continuous wave sets which involve vacuum tubes. Some are using quenched gaps and are sending out wave trains that are very nearly steady. Each wave is only a little weaker than the preceding, that is the decrement is small, and the interference is not nearly so troublesome as it was with the old spark sets. The smaller the decrement the more amateurs can live in peace and harmony within a given radius, for



Early type of wave meter with additional coil for extending its wave length range

the more messages they may transmit through the ether without interfering with each other at the various receiving sets.

Mr. Amateur with the high powered set, are you doing your share? There are two ways to find out. One is to stand by for complaints and comments from others who are trying to carry on communication at a wave length very near that which you are transmitting. The other way is that of self-analysis of which we hear so much today.

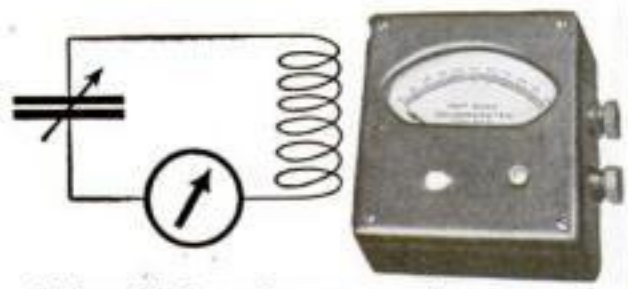
For this you need a wave meter which you can either buy or make.

Recent improved type of wave meter with the coupling coil inclosed in the case

It can be made as follows: make up a tuned circuit, containing a fixed inductance coil and a variable condenser, which has a tuning range on both sides of the wave length in which you are interested. Connect a small sensitive hot wire ammeter like that of Fig. 1

into the circuit as shown below. Your wave meter is now complete.

The condenser and thermal instrument should be mounted in a box and the coil attached to the top of the box on an arm or pivot. This permits the coil to be rotated so as to vary its coupling with the circuit under measurement without having to move the box. The leads to the coil should be separated about an inch and tied to keep them always the same distance apart so that their capacity does not change.



When this hot wire ammeter is connected as shown in diagram we have a wave meter

The next step is to calibrate the wave meter. The simplest way involves getting some friend, who has a good wave meter, to send for you. Or ask some strong station just what his wave length is. To calibrate, you couple the wave meter coil to your antenna coil and tune in your friend. The hot wire ammeter will not be sensitive enough so leave it in circuit but connect your detector across the condenser of the wave meter and receive in the ordinary way. Mark the setting of the condenser and then look for some other wave lengths. Of course if your receiving set is calibrated you need only to switch the wave meter circuit over as a substitute and tune it to receive the same station as you received on your regular set.

The chief use of the wave meter is to check the frequency of your own transmitting set and to tell you how to adjust it so as to have a small decrement. For this purpose couple the wave meter coil to your antenna coil and see what setting of the condenser gives a maximum reading of the ammeter. This gives your wave length. If the ameter reading does not change much as you vary the condenser it means, of course, that your resonance curve is flat, that is that your decrement is high and troublesome to others.—Ten Broeke.

How to Use Your Wave Meter

IF you don't want to be rated as an "etheric pirate," to use Dr. De Forest's phrase, you can protect yourself and your neighbors by the proper use of your wave meter. My method can be learned by an ordinary operator in a half an hour or so.

First couple the primary and secondary of your transmitting set very loosely and then tune. Now couple your wave meter coil to the secondary of your transmitter. If you are not sure what loose coupling really means separate your primary and secondary

coils until the antenna ammeter reads only about ten divisions. If the secondary is really in tune any slight change in its number of turns will make a large reduction in the antenna current.

To use your wave meter. Fig. 1 shows a plan of the top of a meter. First find what wave length you are

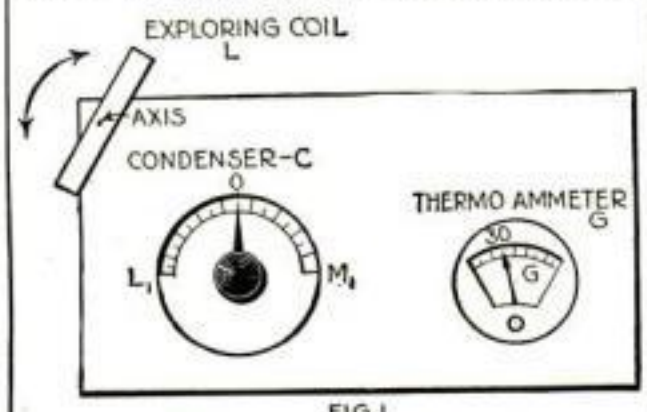


FIG. 1

Schematic view of wave meter. The exploring coil may be rotated to vary the coupling

transmitting. The setting of the condenser when the thermal ammeter shows a maximum current gives this. Of course the exploring coil must not be moved while the condenser is being adjusted. Sometimes radio experimenters have difficulty in telling just what setting of the condenser corresponds to the maximum of the ammeter for they have trouble watching both ammeter and condenser. They complain that the pointer G moves too slowly near its maximum deflection to tell just where this motion stops.

If the power of the transmitter is steady the operator may make several trials and take the average position of

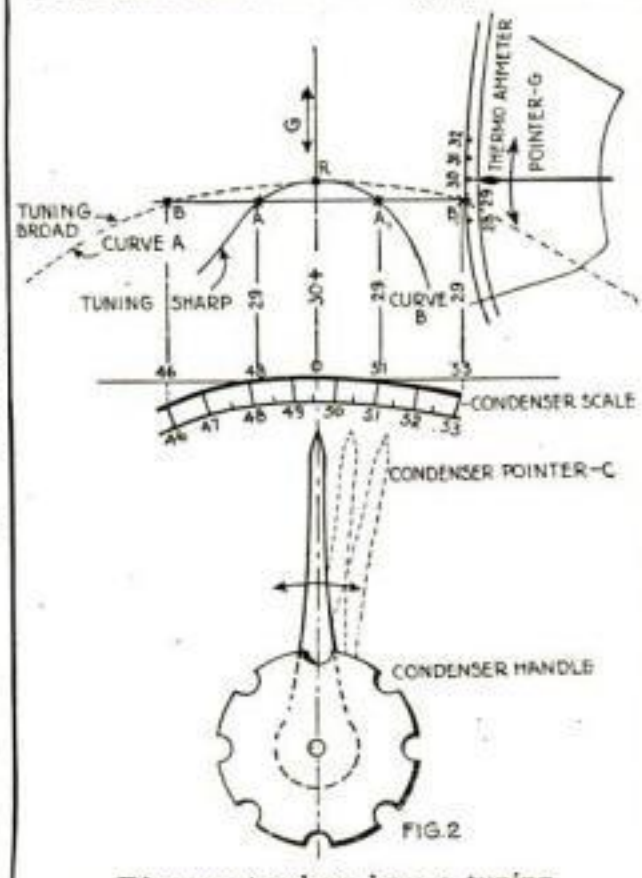


FIG. 2

Diagram to show how a tuning curve depends on condenser and hot-wire ammeter readings

the condenser pointer. You can avoid this, however, and kill two birds with one stone, for you can get both resonance and coupling test in half the time, as follows. When G shows almost the largest reading move C slowly back and forth over several scale divisions. If, meanwhile, G reaches its maximum and retreats you are ready. Watch the positions of C when

G passes the same point, first as the reading increases and then as it decreases. If you can note these two positions of the pointer of C you can regulate your transmitter. Take the average of these to find the proper setting for resonance.

It is best that the amount of "retreat" of the pointer of G from its largest reading be about two scale divisions before the condenser readings are taken. For instance, suppose you observe that 30 seems the largest reading on G. (You can make it read exactly 30 by moving the exploring coil L.) Now move C each way from its setting until G reads 28. If you are a good observer you can use a retreat of only one scale division instead of two.

Now increase the coupling of your transmitting set. Keep the maximum reading of the ammeter at 30 by varying the coupling of the wave meter coil. Test each time as above for resonance and you will soon find that the motion of the condenser pointer has to be about twice as much to cause the same retreat of the ammeter pointer.

You should stop increasing the coupling of your transmitting set when you have to move the condenser through more than twice as much as you did with loose coupling for the same retreat. You may now rest assured that your transmitter is getting at a single frequency, the most energy possible with the power applied to your set.

To show what happens I have drawn the scale of the ammeter G at one side of that for the condenser, as shown in Fig. 2. You can see the form of resonance curve and also that a resonance curve is really built up from two separate motions of a point. A resonance curve is just a plot of ammeter deflections against condenser pointer deflections as shown in the figure.—O. C. Roos.

A New Form of Wireless Aerial

A NEW form of wireless aerial has been experimented with at Scheveningen. It is the invention of a Dutchman named Vlug. The wires for a length of from 100 to 150 metres are lightly buried in the ground. They are said to be highly sensitive, with the result that two wires are insufficient for direct communication with Bandoeng (Dutch East Indies). A receiver placed between the two contains certain improvements of Mr. Vlug's invention. Comparison has been made between this wiring and the large antennae at Scheveningen, by which it was proved that signals were louder on being received through ordinary aerials, but that not a letter was distinguishable owing to the disdurbances. These had not entirely disappeared when enploying the Vlug system but had gained greatly in distinctness, so that not a letter was missed.

Telephoning to a Moving Railway Train

THE question of devising a suitable method by which a telephone conversation may be held with a distant, moving railroad train has lately been revived by the announcement that the War Department has apparently succeeded in so doing. The Department's plan, however,—known as "wired wireless,"—involves a rather intricate system which is also expensive. It is obvious that the telephone apparatus in connection with trains must be simple, rugged, and workable under all sorts of adverse weather conditions. One system has been tried out with interesting results, as evidenced by the photographs.


CANADIAN GOVERNMENT RAILWAYS
SAFETY TELEGRAM FIRST

Copy of the first message sent to a moving train by the telephone system described

If a distant train dispatcher rings, his bell circuit includes Coil A of an induction coil placed convenient to the rails upon which the train is moving. This excites a secondary current in Coil B. This current, of relatively high power, passes through the length of the track and hence to an overhead wire leading back to the Coil B. As this current passes under the car wheels a peculiar phenomenon occurs; for a small proportion of that current, not satisfied with easy sailing along that track, jumps up through the first car wheel, through Coil E in the car, and then back to the rail through the second wheel. This Coil E is associated within the same induction coil with two other coils, C and D. The current set up in Coil E produces still another one in C, and this one is in circuit with the train telephone bell when the receiver is on its hook. The Dispatcher's ring, therefore, rings the bell in the moving train.

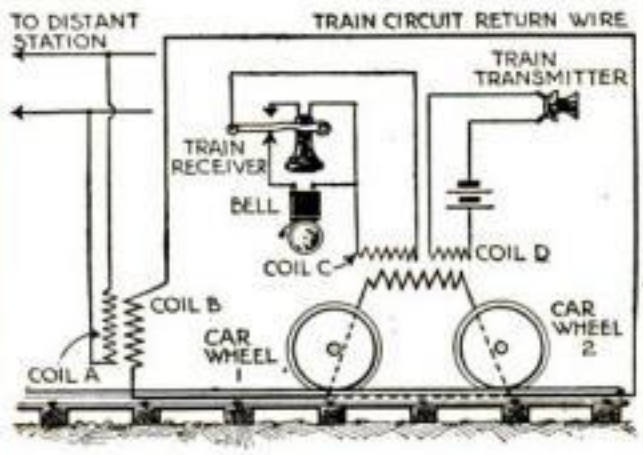


Diagram of connections for sending telephone messages over wire and rails to moving trains

When the train conductor takes the telephone receiver off its hook the bell

circuit is broken, but in its stead the ear piece comes into play, so that the distant voice, traveling just as the bell impulses did, can be heard. Should the train conductor desire to talk, the varying impulses produced by his voice into the train telephone transmitter creates a current through the train transmitter battery circuit in which there is the coil D. The current in Coil D sets up another current in the Coil E, which in turn, traveling along the rail as the bell impulse did, sets up another circuit in Coil A, and this carries the conductor's words to the distant station.—SAMUEL W. BEACH.

The Detector of a Hundred Contact Points

AMATEURS who are still using crystal detectors instead of vacuum tubes will be interested in a design brought forth during the war by a French inventor, M. Hurn.

Ten different silver wires offer ten different points of contact with the crystal. With any one of these, connection may be made by a rotary switch. The crystal is so adapted that it will turn and for each one of the contact wires there are possible twelve fresh points on the crystal surface. There results a total of 120 possible points. The operator has merely to keep turning and he will surely find a contact of the desired sensitivity.

Dial with ten wires for different contacts with crystal

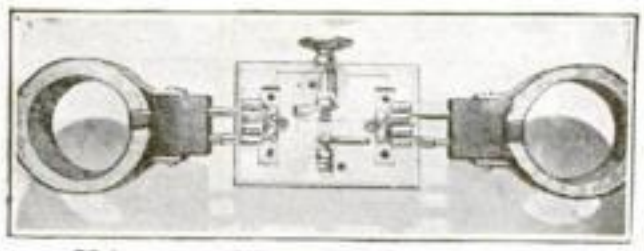
The device is shown in two pictures. In the first are seen the silver wires which form, with a galena crystal, the detector. They pass through the center of an ebonite disk, in groups of five on two small eccentric arcs. On the other side of the disk they meet the crystal. The latter may be turned about an axis passing through the center of the disk and as it does so each wire follows along a separate circular path on the crystal surface.

The other picture, that of the assembled device, shows at the top a small vertical cylinder which may slide up and down. A pin on its side may engage with any of twelve vertical slots and thus hold it fast. To operate, one rotates the switch, testing the ten points thus allowed, and then turns the crystal container to the next slot and repeats with ten fresh points.

This detector gives 120 different adjustments of the silver crystal contact

A New Mounting for Bank-Wound Coils

A SIMPLE mounting of the type needed for use with banked coils or those of the "honeycomb" style is shown in the illustration. A D.P.D.T.



Using porcelain switch base to mount and to couple bank wound coils

switch, such as can be bought for about half a dollar, and a little work is all that is needed.

The contacts of the switch are removed and bolted in the holes that were formerly employed to take care of the lead wires. This is necessary to permit plugging in the standard makes of coils, the contacts of which are rather close together.

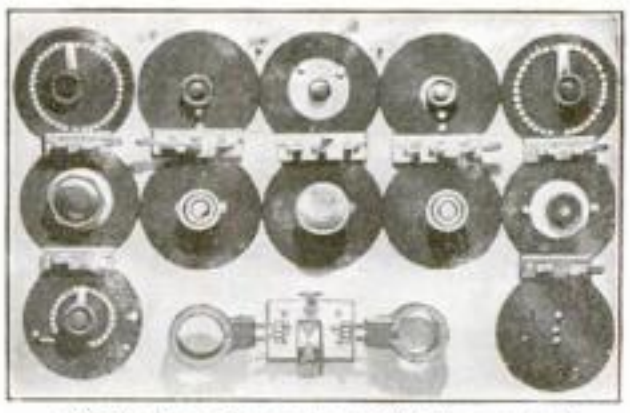
The switch blades are removed. In their places are inserted a male and female plug. One of these is made from a 3/16-in. wire terminal. It is soldered to a long bolt and put in the place of one blade. The other is a piece of heavy copper wire with the end flattened, drilled, and bolted in place of the other switch blade.

Coils plugged in the end contacts are moved by hand. The center coil, which fits into the parts just described, can be moved by a knob, as shown.

Mounting Radio Instruments on a Panel

THE most recent method of mounting instruments, especially those used in the receiving set, is in the form of a panel, the various units being inserted in round or square holes cut expressly for this purpose.

The instruments used may be mounted on disks of fiber or bakelite,



Bristol board panel on which is mounted phonograph disk carrying apparatus

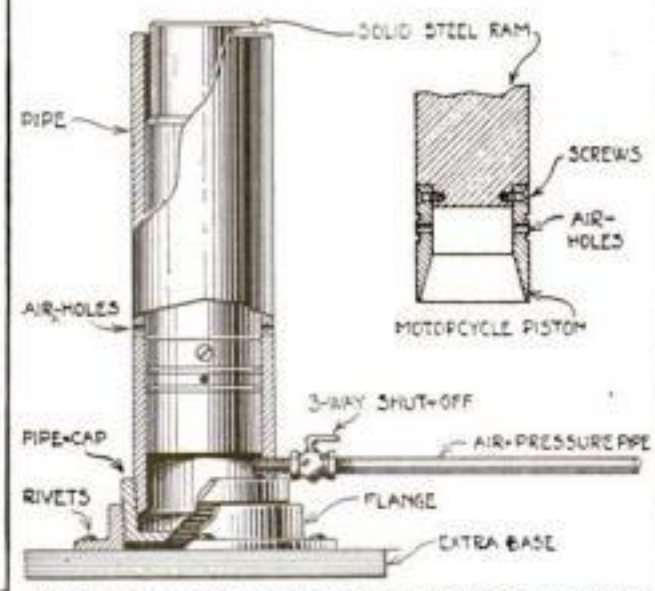
or on old phonograph records, which may be bought cheaply at second hand. Two or four instruments may be held in place at once by fastening small switches or other similar pieces of apparatus on the sash or panel in such a way that they overlap and bind on the edges of the disk mountings.

The author's receiving set is shown herewith. This set costs less than $25 complete, including three homemade vacuum valves.—R. U. CLARK, 3rd.

An Air-Pressure Ram for Garage Use

THERE are numerous cases in garage work where a series of blows, or prolonged pressure, is desired to drive in or out certain parts that cannot be reached with a hammer or bar. To supply such blows or pressure the following ram, working from the air system in the shop, has been devised. It is capable of a blow depending upon the maximum pressure in the supply tank and will be found convenient to use in places not readily accessible to ordinary tools.

The base consists of a large pipe flange, bolted to a supplementary base of heavy sheet iron. This larger base



Made from old engine parts, this air-pressure ram will do excellent work in the garage

is to give the ram stability when working under a movable part of a chasis or in other work of a like nature. Thread a large pipe cap about half way down on the outside so it will fit inside the flange opening, closed end down. This acts as a retaining wall for the air chamber. Then the cylinder to the ram, consisting of 1 ft. of pipe, is threaded into the inside of the cap. Make up all joints tightly as possible, and with lead filling. The sectional illustration shows the manner of assembling. No dimensions of the various parts are given as they depend upon the diameter of the ram itself.

The ram consists of two parts, the pressure end and the hammer. The first is made from a small gas engine piston, about the size used in a four cylinder motorcycle engine. Procure one that will accommodate itself to the inside bore of some standard size of high pressure pipe; about 1½ in. in diameter. This diameter, however, may be varied. Be sure the rings are in good condition and gas tight. Then turn out a piece of solid steel similar to that shown in detail. The neck should make a snug fit inside the open end of the piston, and fasten to it by drilling and tapping several holes about its circumference and using countersunk screws. This places the piston head down when the ram is inserted in the cylinder. The cylinder should, of course, be bored out and smoothed on a lathe before making it up with the rest of the pipe fittings.

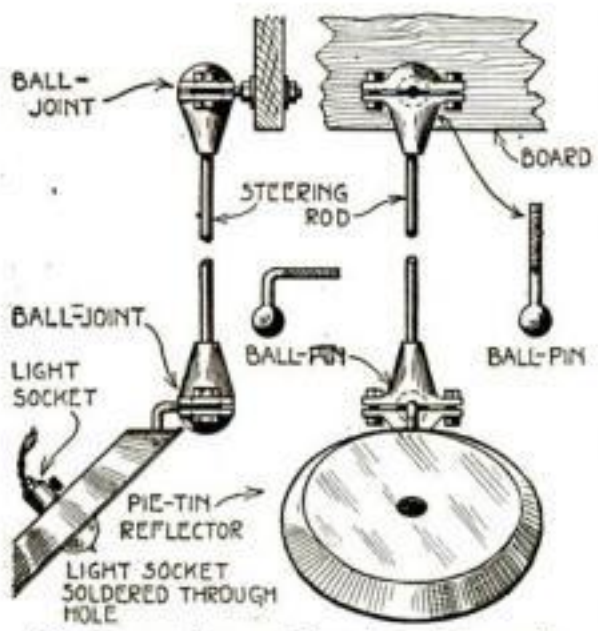
Where the cylinder enters the cap,

drill and tap a hole for the air intake pipe. Seat a three way shut-off in this opening and connect it with the air supply. The end of the shut-off should project a little into the cylinder to act as a rest for the piston when at the end of its down stroke. Just above the top of the piston, drill several small holes about the circumference of the cylinder, to serve as air outlets when the piston rises and reaches that point.

To operate the ram, place it under the part to be driven, turn on the shut-off and admit air to the cylinder. This pushes up the piston, with a sharp blow. By turning the shut-off one way the air is released and the piston drops. This operation is repeated as often as necessary. If the piston reaches too high a point the air pressure escapes through the outlets in the sides of cylinder. The ram is oiled by dropping oil between the ram and cylinder walls at the top.

A Bench Light Bracket Made from Automobile Parts

THE steering rod of a Ford, or other light car, and a pie tin may be combined to make an adjustable electric light bracket and reflector for the work bench. The steering rod should be the one fitted with ball socket joints at each end and the ball pins which fit them should a'so be used. The arrangement is fully illustrated.



There are always old automobile parts around a garage. This article tells you how to make a bench light from them

Bolt one ball pin through a board placed vertically over the bench. Draw up a nut each side so the pin will not turn. To the ball is then attached one end of the steering rod, the socket being tightened over the ball until it can be moved only by considerable pressure.

Bend a second ball pin so it is turned at right angles as shown, about half way down its ength. The ball is then tightened up in the bottom socket of the steering rod. The opening faces out. Then the pin is bolted through the side of a pie tin which is used as a reflector. This holds the tin at an angle when the rod hangs straight down. The light socket is

soldered through a hole in the center of the tin.

If the ball and socket joints work too easily, remove one half of the socket and grind down the flat surface until the halves fit so close to the ball when the nuts are drawn up that some pressure is necessary to turn it. This will enable the rod to hold any position into which it is swung. Do the same with each one and place a little grease in the joints. Wire from the light can be run up the rod to the rosette overhead.—T. HALLETT.

Re-Cutting Worn Files to Renew Them

IN these days of efficiency and high prices, every effort is made by managers of machine shops, automotive plants and other factories to keep operating costs as low as possible. The utilization of articles that were formerly regarded as waste, once they were used, is receiving the attention of various manufacturers who are saving large amounts of money yearly by reclaiming used lubricating oils, dirty waste thrown away by workmen and other articles. The railroads are leaders in this respect, having worked out the problem with the greatest efficiency.

The writer has found during his travels over the United States and Canada, that in the average machine shop, using quantities of files in a year's time, the foreman does not always know that worn files can be recut and so, allows them to be thrown in the scrap heap. In spite of the extensive use of machinery, there is some work which has to be done with a file, since there is no substitute for it in certain lines of work. Files as cutting tools are used so extensively that it will pay to recut them, and

In these high cost of everything days the need to re-use old tools is great. Files can be made new this way

this can be done by the man who sweeps out the shop. It takes only a few minutes of his time, if too many are not allowed to accumulate at one time. Two dozen can be conveniently handled by the shopman without the work interfering with his other duties.

The acid mixture is cheap in price. In fact, many mills and factories have a supply of the acid on hand, as it is used to remove the scale from iron or steel. In the formula given, the proportions of sulphuric acid and water are so combined as to do the recutting in from 10 to 12 hours. All the shopman need do is clean the files and put them into the acid solution before leaving the shop at night. In the morning they will be ready to remove, and they will be found as clean and bright as new.

To get the best results first clean the files with a "file-card." Then put them into a mixture of four ounces of washing soda and one quart of very hot water, scrubbing them with a brush. This removes any oil from them. Then rinse thoroughly so no soda solution will remain, and transfer them to the acid fluid.

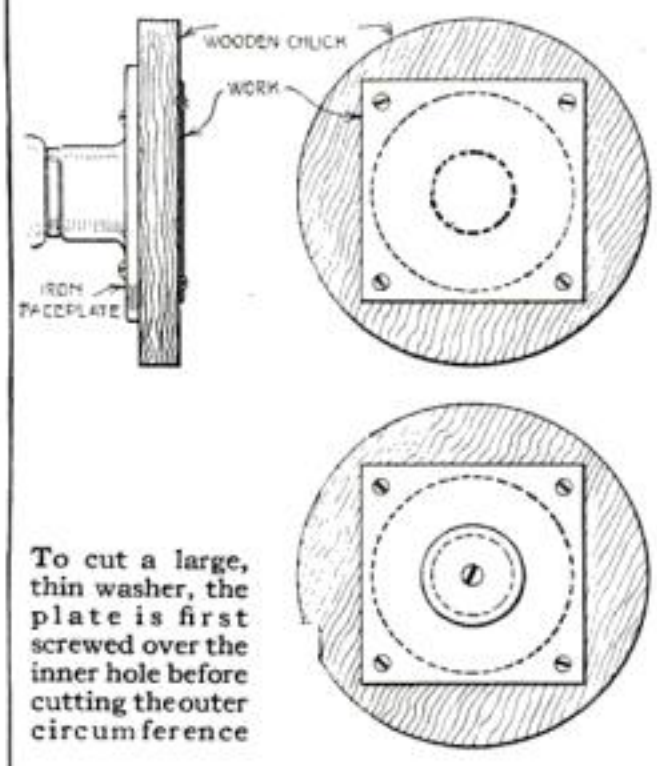
This is made of four ounces of sulphuric acid and one quart of water. To mix it, pour the acid into the water slowly, stirring it with a piece of glass or a stick. Do not reverse this proceeding, or the acid will fly up into your face. Too great care cannot be taken when handling acids. Mix the acid solution in an earthenware or glass vessel, making enough to cover the files. After the files have remained in the fluid 10 or 12 hours, rinse thoroughly in water to remove all traces of the acid, then dry and oil them and put them away until they are wanted for use.

In some localities, the water is alkaline and more acid must be used to counteract this quality. Distilled water will obviate the necessity of adding more acid in using alkaline water. The re-cut files will do good work, and reduce the "overhead cost" to some extent.—W. S. STANDIFORD.

Cutting Thin Disks in the Lathe

THE amateur sometimes experiences difficulty in trying to cut large, thin washers or disks in his lathe. The best way to do this is to attach a wooden chuck to the face plate. This does not need to be round as shown in the illustration, though such a shape facilitates facing it off. It should be faced off smooth and with a plane surface, as shown by applying a straight edge. Then the sheet from which the disk is to be cut is squared up and holes are drilled in the corners for wood screws to attach it to the wooden chuck. The sheet, if kinked, should be carefully straightened, for it must fit evenly on the wood block. If there is any strain on it, the sheet will buckle when the cut is made and probably spoil the work.

The disk is cut out by means of a thin tool something like a cutting-off tool. The center opening is cut first, if a washer is to be made. It would be a good plan to screw a metal or hardwood disk over the hole as shown, in order to help hold the sheet in shape



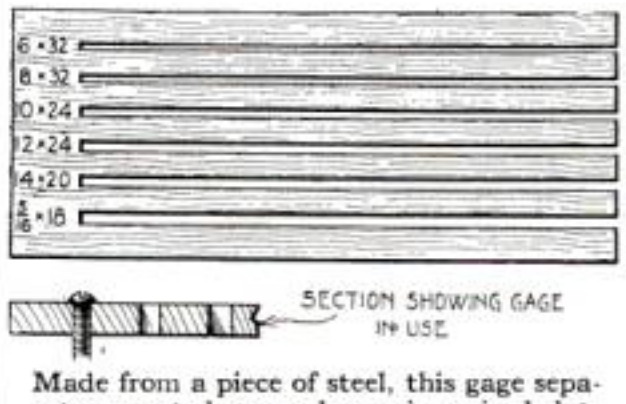
To cut a large, thin washer, the plate is first screwed over the inner hole before cutting the outer circumference

while the outer cut is being made. Too much pressure must not be put upon the cutting tool, for there would be danger of the tool breaking through at one point and spoiling the piece.—H. H. PARKER.

An Accurate and Quick Way to Gage Screws

IN a factory, not long ago, we had two fairly large sized boxes filled with a mixed lot of machine screws, varying in size from 6 in. by 32 in. to 5/16 in. by 18 in. To sort these and put them back in stock looked like a slow, tedious job.

We saved considerable time by making a screw gage as follows: A piece of sheet steel ⅛ in. thick and 12 in. long by 6 in. wide was cut into six slots about 10½ in. long. Each slot



Made from a piece of steel, this gage separates assorted screws by various sized slots

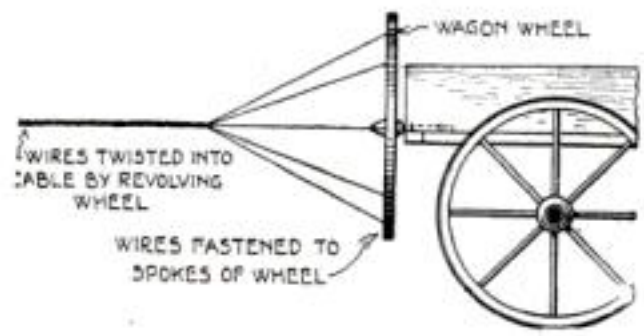
was just wide enough to admit one size of the screws. There was one slot for the 6 wire screw, one slot for the 8 wire screw, etc., with no chance of getting the wrong screw in the wrong slot. The boy could take up a handful of screws and drop them into the slot where that particular size screw belonged. When one slot was full, he could hold the other sizes back while he slid the slot that was full into a box. This method will save a lot of time.—H. BARNUM STILLMAN.

The Right Way to Make Wire Cable

A TELEPHONE line was to be run from a rural community into town, and three men were assigned to the job of putting up the poles and placing the wire. At corners it was recommended to use twisted wire cables, but since there were no cables at local markets and not the time required for a shipment to arrive, it was necessary to make them by hand.

At first the cables were made by securing six or eight wires to a post, and twisting a stick to which the other ends were tied. This resulted in a poorly twisted product. The wire was loose at the stationary end, but tight at the other end. In order to get a cable that was uniform from one end to the other an old iron wheel was bolted to the back of the supply wagon, as shown. The bolt was run through the two by four which formed the rear bed piece of the wagon box.

When it was necessary to make a cable, the wagon was hauled to the side of the road, the brakes locked, and a stout stake set in the ground fifteen or twenty feet from the back end of the



A wagon wheel used as shown will make a tight and uniform wire cable

wagon. Wires were then run from this stake to as many spokes of the wire wheel as there were strands desired, being placed first at the outer edge of the wheel. The stake was then revolved a number of times. The ends of the wires on the spokes were then pushed 2 in. nearer the hub, and a few more turns of the wheel were given. This was kept up until the wires reached the hub and the cable was finished.

With the wires far apart at first, the angle which the strands met was kept approximately constant, which is necessary to result in an even twist. The wagon gave enough under the strain to keep the wires tight, sliding back as the pressure increased. A little practice produced a good cable that was evenly twisted from one end to the other, and which required only a small amount of labor to make.

The same principle has been applied where small lengths of such cable was wanted from time to time, as in fence-making. The wagon was blocked, one rear wheel jacked up, and wires were tied to its spokes. As the wheel revolves it twists the five wires into a uniform cable. The apparatus is easy to make and the few parts may be picked up at small cost.—DALE R. VAN HORN.

DETROIT

The Auto Center is the Logical Place To

LEARN AUTO AND TRACTOR BUSINESS

Training for Head and Hand

The Automobile, Truck and Tractor business, in a few years, has become the world's greatest industry. In amount of capital invested, in number of men employed, in volume of business it exceeds any other industry. Manufacturers tell us it is still in its infancy. The opportunities for Trained Men in this industry are almost beyond belief; future opportunities will be even greater. Prepare yourself to take advantage of these opportunities by learning every phase of the Automobile, Truck and Tractor business as taught by the old reliable Michigan State Auto School, Detroit.

Earn $100 to $400 Monthly

Factories, Garages, and Service Stations everywhere are calling for Trained Men in ever increasing numbers. Hundreds of our students are in business for themselves making $5,000 to $10,000 and more yearly. There are thousands of valuable locations for Garages and Service Stations everywhere—the field is unlimited.

No matter what you have done or what you are doing now, you can *learn this well-paid, pleasant work.* Whether you are young or have reached more mature years, our Courses will fit you to command the opportunities you desire. To the man with grit and the determination to get ahead, the future is without limit. Michigan State Auto School training will help you to success in any branch of the Auto, Truck and Tractor business.

Auto Factories Endorse School

The thoroughness of our methods and the completeness of our equipment are well known in the Auto Industry. The biggest factories in the country heartily endorse our Course. In fact, many of the leading Auto Manufacturers assisted in outlining our Course and they give our students the fullest co-operation possible. These factories are constantly calling on us for graduates because they know the type of men we turn out. Everywhere in the Automobile Industry, M. S. A. S. graduates are given the preference because ours is the Factory Endorsed School.

Cadillac "eight"

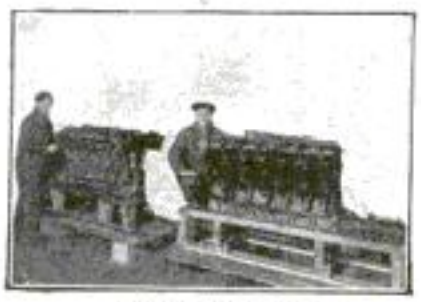
What We Teach

Courses Thorough and Complete

Each student is taught Auto, Truck and Tractor construction in every detail. We train both the head and hand. There are over one hundred motors of all types in our block test department. Our Course in Auto Electrics is very thorough—graduates have no trouble locating any electrical trouble quickly and easily. Students get complete, thorough and practical knowledge of Motors, Starting, Lighting and Ignition Systems, Carburetion, Lubrication, Transmissions, Differentials, etc. As a part of the regular Course, students are given complete and thorough training in the care, repair and operation of Farm Tractors.

Brazing and Welding and Tire Repairing are taught in separate Courses. Either of these Courses may be taken separately but if taken with the regular Automobile Course, make a valuable addition to the equipment of any student.

To men who want to sell Autos, Trucks and Tractors, this training gives an exceptional advantage for they know just how to judge the value of old machines they are asked to take in trade on new machines. They know these machines as no average salesman can know them. School is open all year—you can start any day.



Liberty "twelves"

Modern Equipment

The Cadillac "eight" and the Liberty "twelves" shown here are but a part of our modern equipment. Besides the Libertys, our air-plane motor department includes the Gnome Rotary, Hall Scott, Roberts and Curtiss "8." Instruction on these motors is given in connection with our Complete Automobile Course without extra charge. Because of our enormous equipment our Courses cover latest models as well as models of former years.

Not a One-Man School

This school is founded on the best, newest and most practical principles in the Auto, Truck and Tractor business. Our Course is built with the closest and most liberal co-operation from Manufacturers, Garages, Service Stations, and Owners. It is not one Man's ideas, but the combined ideas of the biggest and most successful men in each field.

A. G. ZELLER
President

Money-Back Guarantee

We guarantee to qualify you for a position as chauffeur, repair man, demonstrator, auto electrician, garage man, automobile dealer or tractor mechanic and operator paying from $100 to $400 monthly, or refund your money.

Start Any Time

School is open the year 'round. Three classes daily, morning, afternoon and evening. You can get started same day you arrive. Our Welfare Department will assist you in finding good rooming and boarding accommodations.

PAIGE-DETROIT

MOTOR CAR COMPANY

DETROIT, MICH., U.S.A.

The Michigan State Auto School bears a very good reputation and we believe turns out good workmen. At present time there seems to be no difficulty for their graduates to secure positions. Very truly yours,

PAIGE DETROIT MOTOR CAR CO.

W. A. Theeler, Factory Manager

BUICK MOTOR COMPANY

FLINT, MICHIGAN

Wish to advise that from all we have been able to learn, the Michigan State Auto School is alright. They have quite a plant here and a large number of students from all over the country.

Of course, do not wish you to construe this letter as in any way guaranteeing them, yet we have never heard anything against them and we have heard a lot of good things. The writer's personal opinion is that they are as good an automobile school as there is in the country.

BUICK MOTOR COMPANY
(Detroit Branch)

Hupmobile

Hupp Motor Car Corporation

Detroit, Michigan, U.S.A.

Having had the pleasure of recently visiting and inspecting most carefully your school, permit me to say that I was deeply impressed with the personnel of your organization, the equipment that you have and the methods you use to teach your students. Yours very truly,

HUPP MOTOR CAR CORPORATION
C. P. Salisbury, Manager Service Department

Send for Big, Illustrated Catalog

Send the coupon today for big illustrated catalog and copy of latest "Auto School News"—both absolutely FREE. They tell about Courses—show more than a hundred pictures of equipment—give letters from big Auto Factories and Graduates. M. S. A. S. Courses are as reasonable in price as they are thorough in their training. Those who have jumped on a train and come to Detroit to investigate our school, have found the Courses so satisfactory and so reasonably priced that they have remained to get the M. S. A. S. Training. Our Money-back guarantee protects you. If you can't come at once, get the catalog. Resolve to learn the business in Detroit—*THE HEART OF THE AUTO INDUSTRY.* Use the Coupon NOW.

THE AUTO INDUSTRY

Use This Coupon NOW

MICHIGAN STATE AUTO SCHOOL,
587 Auto Bldg., 687-91 Woodward Ave.,
Detroit, Mich., U. S. A.

Gentlemen:—Please send me, absolutely FREE, Big, Illustrated Catalog, "Auto School News," and information as checked below.

( ) Auto and Tractor Course ( ) Tire Repairing ( ) Brazing and Welding

Mark each course you are interested in or better still, you may expect me about.....

Name.....

Street.....

City..... State.....

IN THE HEART OF

MICHIGAN STATE AUTO SCHOOL

"Most Progressive Auto School in America"—"In the Heart of the Auto Industry"

587 Auto Building
687-89-91 Woodward Ave. **Detroit, Mich., U.S.A.**

"Here's Your Hires, *Ma'am"*

BE sure you just say "HIRES" when ordering by the case from your dealer, or by the glass at the fountain. By saying "HIRES" you guard against an imitation drink which, being artificial, may be harmful.

Nothing goes into Hires but the pure healthful juices of roots, barks, herbs, berries and pure cane sugar. The quality of Hires is maintained in spite of tremendously increased costs of ingredients. Yet you pay no more for Hires the genuine than you do for an artificial imitation.

Hires carbonated in bottles for the home is the same delightful drink, the same healthful, genuinely-invigorating drink as Hires the fountain favorite.

THE CHARLES E. HIRES COMPANY, PHILADELPHIA

Hires contains juices of 16 roots, barks, herbs and berries

Hires *in bottles*

What Does a Bicycle Owner Really Expect of a Tire?

THERE are probably 3,000,000 bicycles in use in the United States today. There are close to 8,000,000 motor vehicles. The thinking bicycle owner doesn't want tires that are a tire maker's side line. He wants tires, like U. S. Bicycle Tires, that have to live up to the high reputation of the oldest and largest rubber company in the world, the same way U. S. Automobile Tires do.

U. S. Cords, U. S. Chains and seven other treads, clincher and single tube. Free book "Rubber—A Wonder Story," if you write U. S. Rubber Company, Bicycle Tire Division, New York.

"Ride a Bicycle"

United States Tires

United States Rubber Company